

AN ASSESSMENT OF KEY  
BIOLOGICAL RESOURCES IN THE  
DELAWARE RIVER ESTUARY

APPENDICES

**Versar** INC.

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DELAWARE RIVER ESTUARY**

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## APPENDICES

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**APPENDIX A**

**ANNOTATED BIBLIOGRAPHY**

## INTRODUCTION

Presented in this appendix are descriptions of those datasets and publications containing information on the biological resources within the Delaware Estuary. Attempts were made to identify and locate published and unpublished datasets which could be used to identify important biological communities and species, and identify the current status and temporal trends for each. Most of the more significant datasets (i.e., those with large spatial or temporal extent) were identified and described. However, this annotated bibliography is most likely not without omission. Small unpublished datasets, particularly those pertaining to limited geographic regions within the estuary, may have been missed.

All datasets and publications reviewed were included in this appendix. However, not all reviewed datasets were included in the final report. In some cases, datasets were excluded from the final report because the information they contained was redundant with information presented in other datasets. Other datasets were excluded because a thorough review and analysis could not be completed within the scope of this project. In general, unpublished data that did not exist in some kind of electronic format could not be analyzed. These datasets were referenced in the annotated bibliography, but not further treated in the final report.

## ANNOTATED BIBLIOGRAPHY FORMAT

Descriptions of datasets and publications were grouped according to the general type of biological communities being studied. These groups were:

- Phytoplankton;
- Zooplankton--including surveys of the larvae of benthic invertebrates;
- Ichthyoplankton;
- Benthos--excluding landings data for benthic shellfish, which are described with fish communities;
- Fish; and
- Birds.

Descriptions of datasets and publications were organized in a format suggested by the Delaware Estuary Program. Descriptions were presented in eleven categories.

**Category 1--Cited Reference:** The complete bibliographic citation for each dataset was given in this category. Unpublished datasets were also noted here and referenced using the last name of the principal investigator followed by the last year for which data existed in the unpublished dataset followed by the words, "Unpublished data" (e.g., Smith 1985. Unpublished data).

**Category 2--Principal Investigator:** The name, address, and telephone number of the principal investigator was included in this category. Attempts were not made to update addresses for each investigator. Therefore, the date this information was last known to be correct was also given.

**Category 3--Repository of Dataset or Reference:** The origin of each dataset or reference was given here. If a publication existed within the Versar library, Versar was given as the repository. The lending library was given as the repository for publications obtained through inter-library loan. Libraries in the Delaware Estuary area and potentially containing significant collections pertaining to the Delaware Estuary (e.g., Rutgers University library, University of Delaware libraries at Newark and Lewes) were visited, but no attempts were made to check for the possession of previously located publications.

**Category 4--General Data Type:** Listed under this category were the major relevant parameters included in the publication or dataset. This category did not present a list of variables for each dataset. Measured parameters were prefaced by the general type of biological community being studied.

**Category 5--Sample Matrices:** The sample matrix refers to the medium from which samples were taken. Matrices included water (for plankton and fish), sediments (for benthic invertebrates), and air (for birds). The matrix name was followed by the general type of biological community being studied.

**Category 6--Sampling Design:** Category 6 contained details about sampling design and included a brief description of the purpose of the study, beginning and ending sample dates, the frequency of sampling, and the number of sampling stations in the study.

Sample locations were also given under this category. Where possible, individual sampling locations were listed along with the DRBC River km (DRBC 1988) and the coordinates for latitude and longitude. In most cases, coordinates were not given and no attempts were made to estimate coordinates from figures since such estimates are inherently inaccurate. For studies reporting station locations in figures only, locations and DRBC River km were reported as ranges (e.g., the mouth of the estuary to the Chesapeake and

Delaware Canal, DRBC River km 0 to 93). Accessory information describing river conditions at the time of sampling (e.g., flow, salinity, temperature, sample depth, or station depth) were not presented in this section.

**Category 7--Sampling and Analysis Methodologies:** Information on sample gear, sample methods, and specific analyses were presented in this category. Descriptive information was given concerning net, sieve, or filter sizes, and the area or volume of each sample. The sample methodology category also included information on specific quality control measures which may have been used, separately noting the number of replicate samples taken.

**Category 8--Data Processing:** This category summarizes significant data transformations used in preparation of the publication. For example, mention would be made here if data were collected monthly, but reported in the publication as annual means.

**Category 9--Data Evaluation Results:** Where possible, comments on the general quality of the dataset were placed in this category. The approach used to complete data quality evaluation is summarized in the data quality section below.

**Category 10--Companion Studies:** Publications using the same or similar datasets were listed in this category.

**Category 11--Comments:** Specific comments concerning the use of specific datasets and publications to assess the status and trends of biological resources were placed in this category. Comments are also included concerning any known limitations of the dataset and any additional comments that were not appropriately placed in other categories.

## **DATA QUALITY CRITERIA**

The evaluation of the quality of biological datasets reviewed for this project was difficult. Most datasets lacked complete documentation concerning the methods employed and quality control measures. Those studies for which methods were described, presented methodological descriptions which were generally inadequate to evaluate data quality. For example, mention that chlorophyll *a* concentrations were measured using a Turner Fluorometer is inadequate if mention is not made of standards used and how instrument drift was corrected.

The vast majority of the data reviewed for this project were collected during field surveys or monitoring projects or programs. The possible sources of error associated with these types of data may be generally grouped in two categories:

- Errors due to sampling and
- Errors due to sample processing.

Sampling errors include those of improper station positioning and inadequate or improper collection of samples. Accurate station positioning is important where temporal trends for a specific area need to be assessed. If positioning is inaccurate, particularly in heterogeneous areas, apparent temporal changes may be due to sampling different biological communities and not due to real biological changes. With few exceptions, documentation accompanying datasets or publications did not describe how station location was determined. It is likely that for most studies prior to about 1970-1975, station location was determined by triangulating visual sightings along fixed reference points on land. Depending upon the distance from fixed reference points, visibility, and sea state, visual positioning can be fairly accurate. Electronic navigational systems (LORAN, for example) are more accurate, but have not been generally available and affordable prior to the mid-seventies. Therefore, most sample locations could be considered as approximations only and errors due to sample location could not be quantitatively assessed.

Methods used to collect biological samples are many and must be judiciously chosen to efficiently sample the community or population of interest. Our review of Delaware Estuary datasets attempted to evaluate whether the methods employed were adequate to meet the general objectives of the study. For example, use of a 10  $\mu\text{m}$  mesh plankton net is adequate to study larger and chain-forming phytoplankton, but is inadequate to study small diatoms or flagellates. Mention of sample collection problems apparent from our evaluations were mentioned in Category 9 (Data Evaluation Results) of the Annotated Bibliography.

Estimates of sampling error may be made when information concerning sample replicates is presented. Because of this, the existence of replicate samples was separately noted in category 7 (Sampling and Analysis Methodologies) of the Annotated Bibliography.

Errors introduced with sample processing were also difficult to evaluate. Most studies presented general descriptions of methodologies and lacked descriptions of specific procedures necessary to adequately make evaluations. When appropriate, comments concerning inadequate sample processing (preservation, sample splitting, reference standards, etc.) were included in the Annotated Bibliography. These comments were generally placed in Category 9 (Data Evaluation Results).

It was impossible to evaluate the taxonomic expertise of specific investigations. Quality control measures to insure accurate taxonomic identification were not given. In most cases, reference collections were not

made to each study and samples were not archived. Species lists were reviewed for obvious or suspect mismatches. However, in absence of data to the contrary, taxonomic identification was assumed to be correct.

The publications referenced in the Annotated Bibliography are listed separately in Appendix C of this report (Delaware Estuary Bibliography).

## PHYTOPLANKTON

**1. Cited Reference:**

Academy of Natural Science of Philadelphia. 1974. Ecological Studies in New Jersey, Oldmans Creek, Raccoon Creek, Birch Creek and Delaware River 1972-1973. Interim Report for Shell Oil Company. Philadelphia, PA. 406 p.

**2. Principal Investigator:**

**Name:** Academy of Natural Sciences of Philadelphia

**Address:** Department of Limnology  
19th and the Parkway  
Philadelphia, PA 19103

**Telephone:** (215)299-1097

**As of (date):** 1990

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Phytoplankton, taxonomic composition, abundance

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** To establish relative productivity of phytoplankton in the study area.

**Sample Dates:** **Beginning:** May 1972 **End:** July 1973

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 8

## Sample Locations:

General Location	DRBC River km	Coordinates
DR-1 - Near Little Tinicum Island, NJ side	139	39° 51'10" - 75° 17'50"
DR-2 - Opposite DR-1	139	39° 50'45" - 79° 17'50"
DR-3 - Transect from Oldman's Creek, PA side	125	39° 47'30" - 72° 26'40"
DR-4 - Transect from Oldman's Creek, NJ side	124	39° 47' - 75° 26'15"
DR-5 - Below Del. Mem. Bridge, NJ side of channel	106	39° 41' - 75° 30'45"
DR-6 - Below Del. Mem. Bridge, NJ shore	106	39° 41' - 75° 30'45"
DR-7 - In Del. R. about 1000 yards above Birch Creek	127	39° 49'45" - 75° 22'10"
DR-8 - Near Wilmington Ferry slip	118	39° 44' - 75° 28'40"

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Plankton net

**Number of Replicate Samples:**

Existence of replicate samples not mentioned.

**Area or Volume per Replicates:** 50 liters water sieved

**Net, sieve, or filter size:** 10  $\mu\text{m}$

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Raw data were presented and collected data were summarized in publication.

**9. Data Evaluation:**

No specific quality assurance procedures referenced.

**10. Companion Studies:**

**11. Comments:**

**1. Cited Reference:**

Botton D.L., Watling and A. Pembroke. 1976. Phytoplankton. 57p. In: Ecological studies on benthic and planktonic assemblages in lower Delaware Bay. L. Watling and D. Maurer, eds. National Science Foundation, Research Applied to National Needs Program (NSF/RANN).

**2. Principal Investigator:**

**Name:** Dr. Robert Biggs  
**Address:** University of Delaware  
Newark, DE 19711  
**Telephone:** (302) 738-2842 As of (date): 10/76

**3. Repository of data set or reference:**

University of Delaware, Morris Library, Newark, DE

**4. General Data Type:**

**Parameters measured:** Phytoplankton, abundance, taxonomic diversity

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** Investigate taxonomy and population dynamics of phytoplankton in lower Delaware Bay. Discuss the primary producer groups.

**Sample Dates:** Beginning: June 13, 1974. End: May 28, 1975

**Sample Frequency:** Monthly or bimonthly

**Number of Sampling Stations:** 3

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Bay - adjacent to Mispillion River	≈ 18	Specific coordinates not given in publication but shown in Figure 1 of Watling et al. 1979

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin bottle sample, plankton net (towed on 10 out of 16 cruises)

**Number of Replicate Samples:** 3 (wholewater), only 1 tow at surface w/net

**Area of Volume per Replicates:** 25 ml each

**Net, sieve, or filter size:** #20

**Other methodologies:**

**Quality control measures:** Samples stored in dark, at least 25 fields were counted, no cells below 3  $\mu\text{m}$  in size were counted

**8. Data Processing:**

Paper reports density and taxonomic diversity for each cruise.

**9. Data Evaluation:**

No specific quality assurance procedures referenced.

**10. Companion Studies:**

Watling et al. 1979 (uses same dataset)

**11. Comments:**

Taxonomy and abundance data used to describe status of phytoplankton community in lower Bay.

**1. Cited Reference:**

Culberson, C.H., T.M. Church, A.C. Frake, J.H. Sharp, J.R. Pennock, S.E. Pike, B.W. Lee, J.R. Scudlark, R.B. Biggs and J.M. Tramontano. 1987a. Data from SALT cruises September 1980-July 1981. University of Delaware Oceanographic Report of Delaware, Newark, Delaware. 78 p.

**2. Principal Investigator:**

Name: Dr. Charles H. Culberson  
Address: College of Marine Studies  
University of Delaware  
Newark, DE 19716  
Telephone:(302)645-4000 As of (date): 1988

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

Parameters measured: Phytoplankton, chlorophyll a and production

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

Purpose of Study: Collection of chemical, physical, and biological data from Delaware Bay and River  
Sample Dates: Beginning: September 1980 End: July 1981  
Sample Frequency: 7 cruises  
Number of Sampling Stations: 30

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Given in report on pages 11, 13, 15, 17, 19, 21 and 23.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** PVC Niskin bottles

**Number of Replicate Samples:** not given in report

**Area of Volume per Replicates:** 10 liters

**Net, sieve, or filter size:** none

**Other methodologies:**

**Quality control measures:** Used fluorometric analysis of acetone extracts, Strickland and Parsons 1972

**8. Data Processing:**

Data presented for each station all 7 cruises

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1983, 1985; Pennock and Sharp 1986; Pennock et al. 1983; Sharp et al. 1980; Culberson 1988; Culberson et al. 1987b, 1987c, 1988

**11. Comments:**

Data analyzed and presented in Pennock and Sharp 1986.

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

**1. Cited Reference:**

Culberson, C.H., J.R. Pennock, B.W. Lee, R.B. Biggs, T.M. Church and J.H. Sharp. 1987b. Data from the YABLED cruises, September 1981-July 1984. University of Delaware Oceanographic Report Number 4. Delaware Sea Grant College Program, University of Delaware, Newark, Delaware. 170 p.

**2. Principal Investigator:**

**Name:** Dr. Charles H. Culberson  
**Address:** College of Marine Studies  
University of Delaware  
Newark, DE 19716

**Telephone:** (302)645-4000 **As of (date):** 1988

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Phytoplankton, chlorophyll a and production

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** Present physical, chemical and biological data collected in Delaware Bay and River.

**Sample Dates: Beginning:** Sept. 1981 **End:** July 1984

**Sample Frequency:** 18 cruises

**Number of Sampling Stations:** 30

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Given in report on pages 12, 13, 15, 17, 19, 22, 25, 27, 30, 33, 35, 37, 38, 41, 42, 45, 48, 50, 53, 56 and 59.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin bottle

**Number of Replicate Samples:** not given in report

**Area of Volume per Replicates:** 10 liters

**Net, sieve, or filter size:** none

**Other methodologies:**

**Quality control measures:** Used fluorometric analysis of acetone extracts, Strickland and Parsons 1972.

**8. Data Processing:**

Data presented for each station for all 18 cruises.

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1983, 1985; Pennock and Sharp 1986; Pennock et al. 1983; Culberson 1988; Culberson et al. 1982, 1987a, 1987c; Sharp et al. 1980.

**11. Comments:**

Data analyzed and presented in Pennock and Sharp 1986

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

**1. Cited Reference:**

Culberson, C.H., J.R. Pennock, B.W. Lee, R.B. Biggs, T.M. Church, and J.H. Sharp. 1987c. Oceanographic Data Report Number 5: YABLED Cruises Part II. Data From YABLED 17 - YABLED 26, January-October 1985. Delaware Sea Grant College Program, Newark, DE. 58 p.

**2. Principal Investigator:**

**Name:** Dr. C.H. Culberson

**Address:** College of Marine Studies  
University of Delaware

**Telephone:** (302)645-4000 **As of (date):** 1988

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Phytoplankton, chlorophyll a, and production

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** Presents physical, chemical and biological data from Delaware Bay and River.

**Sample Dates: Beginning:** January 1985 **End:** October 1985

**Sample Frequency:** 9 cruises

**Number of Sampling Stations:** Up to 29

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212 km	Given in report, pages 10, 12, 14, 16, 18, 20, 26 and 28

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin bottles

**Number of Replicate Samples:** not given in report

**Area of Volume per Replicates:** 10 liters

**Net, sieve, or filter size:** None

**Other methodologies:**

**Quality control measures:** Strickland and Parsons 1972, fluorometric analysis of acetone extracts used to determine chlorophyll a

**8. Data Processing:**

Data presented for each station and all 9 cruises.

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock and Sharp 1986; Culberson 1988; Culberson et al. 1982, 1987a, 1987b; Sharp et al. 1980

**11. Comments:**

Data analyzed and presented in Pennock and Sharp 1986.

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

1. **Cited Reference:**  
Culberson, C.H., J.H. Sharp, T.M. Church, and B.W. Lee. 1982. (Revised 1987). Data from the SALSX cruises May 1978-July 1980. University of Delaware Oceanographic Data Report Number 2. Delaware Sea Grant College Program, University of Delaware, Newark, DE. 66 p.
  
2. **Principal Investigator:**  
**Name:** Dr. C.H. Culberson  
**Address:** College of Marine Studies  
University of Delaware  
Newark, DE 19716  
**Telephone:** (302)645-4000 **As of (date):** 1988
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, chlorophyll a and production
  
5. **Sample Matrices:**  
Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** To present chemical, biological and physical data collected in the Delaware River and Bay  
**Sample Dates:** **Beginning:** May 1978 **End:** July 1980  
**Sample Frequency:** 6 cruises  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Given in report on pages 4, 8, 12, 17, 18, 23, and 29.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin bottle

**Number of Replicate Samples:** none given in report

**Area of Volume per Replicates:** 10 liters

**Net, sieve, or filter size:** none

**Other methodologies:**

**Quality control measures:** Used fluorometric analysis of acetone extracts, Strickland and Parsons 1972.

**8. Data Processing:**

Data given for each station, all cruises.

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1983, 1985; Pennock and Sharp 1986; Pennock et al. 1983; Sharp et al. 1980; Culberson 1988; Culberson et al. 1987a, 1987b, 1987c.

**11. Comments:**

Data analyzed and presented in Pennock and Sharp 1986.

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

1. **Cited Reference:**  
Culberson, C.H. 1988. Delaware Bay Database (Version 1.03). Delaware Sea Grant Program, University of Delaware, Newark, Delaware.
  
2. **Principal Investigator:**  
**Name:** Dr. Charles H. Culberson  
**Address:** College of Marine Studies  
University of Delaware  
Newark, DE 19716  
**Telephone:** (302)645-4000 **As of (date):** 1988
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, chlorophyll a and production
  
5. **Sample Matrices:**  
Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Collect and present chemical and physical data from the Delaware Bay and River  
**Sample Dates: Beginning:** May 1978 **End:** Oct 1985  
**Sample Frequency:** 40 cruises  
**Number of Sampling Stations:** Approximately 30

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Given in report on pages 4, 8, 12, 17, 18, 23, and 29.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin bottle

**Number of Replicate Samples:** none given in report

**Area of Volume per Replicates:** 10 liters

**Net, sieve, or filter size:** none

**Other methodologies:**

**Quality control measures:** Used fluorometric analysis of acetone extracts, Strickland and Parsons 1972.

**8. Data Processing:**

Data presented for every cruise and station

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1983; Pennock 1985; Pennock and Sharp 1986;  
Pennock et al. 1983; Sharp et al. 1980; Culberson 1982;  
Culberson et al. 1987a, 1987b, 1987c.

**11. Comments:**

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

**1. Cited Reference:**

Fisher, T.R., L.W. Harding, Jr., D.W. Stanley and L.G. Ward. 1988. Phytoplankton, nutrients and turbidity in the Chesapeake, Delaware and Hudson estuaries. Estuarine, Coastal and Shelf Science. 27:61-93.

**2. Principal Investigator:**

**Name:** Thomas R. Fisher  
**Address:** University of Maryland  
Horn Point Environmental Labs  
Cambridge, MD 21613  
**Telephone:** (301)228-8200 **As of (date):** Feb 1988

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Phytoplankton, chlorophyll a

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** To address the role and fate of nutrients from freshwater inputs in 3 estuaries and estimate the abundance of phytoplankton focusing on horizontal and vertical gradients of turbidity, nutrients and phytoplankton.

**Sample Dates:** **Beginning:** Nov 1982 **End:** Oct 1983

**Sample Frequency:** 5 cruises

**Number of Sampling Stations:** 8

**Sample Locations:**

General Location	DRBC River km	Coordinates
5 miles southeast of Cape Henlopen, Delaware to Philadelphia	0 to ≈ 130	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 6-liter Niskin bottles

**Number of Replicate Samples:** none given in publication

**Area of Volume per Replicates:** none given in publication

**Net, sieve, or filter size:** none used

**Other methodologies:**

**Quality control measures:** Used acetone extraction and fluorometric methods (Strickland and Parsons 1972).

**8. Data Processing:**

Summary of 5 cruises, 3 of which were on Delaware

**9. Data Evaluation:**

**10. Companion Studies:**

Harding et al. 1986

**11. Comments:**

1. **Cited Reference:**  
Harding, L.W., Jr., B.W. Meeson and T.R. Fisher. 1986.  
Phytoplankton production in two east coast estuaries:  
Photosynthesis - light functions and patterns of carbon  
assimilation in Chesapeake and Delaware Bays. Estuarine, Coastal  
and Shelf Science. 23:773-806.
  
2. **Principal Investigator:**  
**Name:** Lawrence W. Harding, Jr.  
**Address:** Chesapeake Bay Institute  
The Johns Hopkins University  
Shady Side, MD 20764  
**Telephone:** (301)867-7550 **As of (date):** Jan 1986
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, chlorophyll a and  
production
  
5. **Sample Matrices:**  
Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** To provide data on primary production in  
Chesapeake and Delaware bays and compare  
the two, and primary production of inorganic  
nutrients.  
**Sample Dates: Beginning:** March 1982 **End:** April 1983  
**Sample Frequency:** 6 cruises  
**Number of Sampling Stations:** 8  
  
**Sample Locations:**

General Location		DRBC River km	Coordinates		
DB-1 - Nov. 82 -	I Cape Henlopen	0-130	I = 38°45.6'	75°	
	II Fourteen Ft. Bank			01.	
	III Philadelphia		II = 39°06.0'	6'	75°
	IV Deepwater Pt.			09.	4'
			III = 39°51.6'	75°	13.
			IV = 39°40.6'	75°	30.
					2'
				N-Lat.	W-Lon
DB-2 - Apr. 83	I Cape Henlopen				
	II Fourteen Ft. Bank				
	III Ship John Shoal		I = 38°44.7'	75°	
	IV C&D Canal			01.	
				4'	
			II = 39°03.0'	75°	
				11.	
			III = 39°20.3'	0'	
				26.	
			IV = 39°30.8'	75°	
				1'	
				32.	
				7'	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin bottle or diaphragm pump cast

**Number of Replicate Samples:** none given in publication

**Area of Volume per Replicates:** none given in publication

**Net, sieve, or filter size:** none

**Other methodologies:**

**Quality control measures:** Used acetone extracts and fluorometric methods to estimate chlorophyll a (Strickland and Parsons 1972).

**8. Data Processing:**

Reported data analysis for chlorophyll a distribution and productivity in the Delaware.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Gives chlorophyll numbers from the mouth to upper estuary stations. Used a horizontal transect underway sampling plan to act a profile of the salinity gradient then chose 4 or 5 stations along the transect to conduct 24 hr measurements of rate processes.

1. **Cited Reference:**  
Ichthyological Associates, Inc. 1974. An ecological study of the Delaware River in the vicinity of the Edgemoor Power Station Progress Report, October-December 1973. Ichthyological Associates, Inc., Wilmington, DE (Delaware Power and Light Co.).
  
2. **Principal Investigator:**  
**Name:** Edward C. Raney, Ph.D., Director  
**Address:** 301 Forest Drive  
Ithaca, NY 14850  
**Telephone:** (607)533-8801 **As of (date):** Feb 1974
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, chlorophyll a
  
5. **Sample Matrices:**  
Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Emphasis on taxonomic identification and chlorophyll a analysis from which estimates of standing crop can be deduced  
**Sample Dates: Beginning:** May 1973 **End:** Dec 1973  
**Sample Frequency:** Monthly - Nov, biweekly - Dec  
**Number of Sampling Stations:** 5

**Sample Locations:**

General Location	DRBC River km	Coordinates
1. Within 50 yards of discharge outfall 2. 100 yards due south of duPont Edgemoor trestle and mooring site 3. On transect of Edgemoor power station 4. At bell buoy #2 5. 10 yards downstream from discharge tunnels in affluent canal of Edgemoor	$\approx$ 70-72	Specific coordinates not given in report

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Van Dorn Bottle

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** 250 ml

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Samples kept cool and in darkness until laboratory analysis.

**8. Data Processing:**

Data given for each sample taken according to date and depth

**9. Data Evaluation:**

No specific quality assurance procedures referenced.

**10. Companion Studies:**

Unrah and Kraut 1974

**11. Comments:**

Good general study with chlorophyll a numbers in region 2.  
Genera given for algae commonly found in the vicinity of  
Edgemoor Power Station.

1. **Cited Reference:**  
Maurer, D. 1974a. Biological condition of the deep-water portion of lower Delaware Bay. Lewes Field Station, Lewes, Delaware. Grant No. 33369. USF/RANN. 95 p.
2. **Principal Investigator:**  
Name: Don Maurer  
Address: CA State University, Long Beach  
Southern CA Ocean Study Consortium  
Long Beach, CA 90840  
Telephone: (213)985-7874 As of (date): 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Phytoplankton, taxonomic composition
5. **Sample Matrices:**  
Water - phytoplankton
6. **Sampling Design:**  
Purpose of Study: Describe seasonality of phytoplankton in deep-water portion of Delaware Bay.  
Sample Dates: Beginning: 1968 End: 1971  
Sample Frequency: Used literature  
Number of Sampling Stations: Used literature

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of the Delaware Bay to the Chesapeake and Delaware canal	0 to 94	Specific coordinates not given in report. Refer to Fig. 1, page 8.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Used literature from 1968 to 1971. Specifics not given in this publication.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Monthly results given

**9. Data Evaluation:**

No specific quality assurance procedures referenced

**10. Companion Studies:**

Maurer 1974b

**11. Comments:**

1. **Cited Reference:**  
Maurer, D. 1974b. Impacts of a deepwater terminal: Volume I, Environmental problems associated with a deepwater port in the Delaware area. Philadelphia Academy of Natural Sciences, The University of Delaware and Rutgers University. Grant No. GI 33369, NSF/RANN. 206 pp.
  
2. **Principal Investigator:**  
Name: Don Maurer  
Address: CA State University, Long Beach  
Southern CA Ocean Study Consortium  
Long Beach, CA 90840  
Telephone: (213)985-7874 As of (date): 1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Phytoplankton
  
5. **Sample Matrices:**  
Water - phytoplankton
  
6. **Sampling Design:**  
Purpose of Study: Describe types of phytoplankton in deep-water portion of Delaware Bay  
Sample Dates: Beginning: 1969 End: 1970  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of the Delaware Bay to the Chesapeake and Delaware Canal	0 to 94	Specific coordinates not given in report

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Used literature up to 1974  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
8. **Data Processing:**  
Monthly results - or seasonality given
9. **Data Evaluation:**  
No specific quality assurance procedures referenced
10. **Companion Studies:**  
Maurer 1974a
11. **Comments:**

**1. Cited Reference:**

Pennock, J.R. 1983. Regulation of phytoplankton, carbon and nitrogen production in the Delaware estuary. Ph.D. diss. University of Delaware. 289 pp.

**2. Principal Investigator:**

Name: Jonathan R. Pennock  
Address: Marine Environmental Science Consortium  
Dauphin Island, Alabama 36528  
Telephone: (205)861-2141 As of (date): Nov. 1990

**3. Repository of data set or reference:**

University of Delaware, Morris Library, Newark, DE

**4. General Data Type:**

Parameters measured: Phytoplankton, chlorophyll a production

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** Examine phytoplankton production rates in the Delaware estuary in relation to the salinity/turbidity gradient over several seasonal cycles.

**Sample Dates:** Beginning: Oct 1980 End: Jan 1983

**Sample Frequency:** 19 cruises total

**Number of Sampling Stations:** ≈ 36

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Specific coordinates not given in dissertation. See Fig. 2-1, p. 59.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 10 liter Niskin bottles

**Number of Replicate Samples:** Existence of replicates not mentioned.

**Area of Volume per Replicates:** 65 ml

**Net, sieve, or filter size:** none

**Other methodologies:**

**Quality control measures:** Used fluorometric analysis of acetone extracts, Strickland and Parsons 1972.

**8. Data Processing:**

Averaged monthly chlorophyll a and production numbers presented

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1985; Pennock and Sharp 1986; Pennock, Sharp and Canzonier 1983; Culberson 1988

**11. Comments:**

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

1. **Cited Reference:**  
Pennock, J.R. 1985. Chlorophyll distributions in the Delaware estuary: Regulation by light limitation. Estuarine, Coastal and Shelf Science. 21:711-725.
2. **Principal Investigator:**  
Name: Jonathan R. Pennock  
Address: Marine Environmental Science Consortium  
Dauphin Island, AL 36528  
Telephone: (205)861-2141 As of (date): Nov 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Phytoplankton, chlorophyll a flow rates
5. **Sample Matrices:**  
Water - phytoplankton
6. **Sampling Design:**  
Purpose of Study: Examination of the role of suspended sediments and mixed-layer depth in regulating the spatial distribution and temporal response of phytoplankton to nutrient-rich conditions  
Sample Dates: Beginning: Oct 1980 End: Jan 1983  
Sample Frequency: 19 cruises  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Specific coordinates not given in dissertation. See Fig. 1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 10 liter Niskin bottle

**Number of Replicate Samples:** none mentioned in publication

**Area of Volume per Replicates:** none given in publication

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Used acetone extracts and fluorometric methods for chlorophyll a analysis (Strickland and Parsons 1972).

**8. Data Processing:**

Results reported for every other month

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1983; Pennock and Sharp 1986; Pennock, Sharp and Canzonier 1983; Culbreson 1988.

**11. Comments:**

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

1. **Cited Reference:**  
 Pennock, J.R. and J.H. Sharp. 1986. Phytoplankton production in the Delaware estuary: temporal and spatial variability. Mar. Ecol. Prog. Sci. 34:143-155.
  
2. **Principal Investigator:**  
**Name:** Jonathan Pennock  
**Address:** Marine Environmental Science Consortium  
 Dauphin Island, AL 36528  
**Telephone:** (205)861-2141 **As of (date):** Nov 1990
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, chlorophyll a and production
  
5. **Sample Matrices:**  
 Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Annual areal productivity is estimated, and inter-annual variability in phytoplankton productivity is presented and related to physiological parameters associated with photosynthesis.  
**Sample Dates:** **Beginning:** Oct 1980 **End:** Aug 1985  
**Sample Frequency:** Mean monthly intervals with increased sampling during spring bloom  
**Number of Sampling Stations:** ≈ 30

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Specific coordinates not given in dissertation

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin bottles

**Number of Replicate Samples:** none given in publication

**Area of Volume per Replicates:** not given in publication

**Net, sieve, or filter size:** none

**Other methodologies:**

**Quality control measures:** Used Strickland and Parson's 1972 method of acetone extraction and fluorometric analysis of chlorophyll a.

**8. Data Processing:**

Seasonal variations shown, temporal and spatial trends and status

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1983; Pennock 1985; Pennock, Sharp, Canzonier 1983; Culberson 1988.

**11. Comments:**

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

1. **Cited Reference:**  
 Pennock, J.R., J.H. Sharp and W.J. Canzonier. 1983.  
 Phytoplankton. 23 p. In: The Delaware Estuary: Research as  
 Background for Estuaries Management and Development (J.H.  
 Sharp, ed.) University of Delaware and New Jersey Marine  
 Sciences Consortium. 326 p.
  
2. **Principal Investigator:**  
**Name:** Dr. Jonathan H. Sharp  
**Address:** University of Delaware  
 Lewes, DE  
**Telephone:** (302)645-4259 **As of (date):**
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, chlorophyll a production
  
5. **Sample Matrices:**  
 Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Examine biomass, taxonomy, growth rate and  
 nitrogen uptake rates of phytoplankton to  
 estimate the overall impact of nutrient  
 enrichment on the health of an estuary.  
**Sample Dates:** **Beginning:** Sept 1981 **End:** March 1983  
**Sample Frequency:** Mean monthly intervals  
**Number of Sampling Stations:** ≈ 30

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Specific coordinates not given in publication.

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Not given - summary outside using literature  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
8. **Data Processing:**  
Seasonal trends shown for 81, 82 and 83
9. **Data Evaluation:**
10. **Companion Studies:**  
Pennock 1983; Pennock 1985; Pennock and Sharp 1986;  
Culberson 1988
11. **Comments:**



**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 8.1 liter Van Dorn bottle

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** not given in publication

**Net, sieve, or filter size:** none used

**Other methodologies:**

**Quality control measures:** Acetone extracts used for chlorophyll a analysis (Lorenzen 1967)

**8. Data Processing:**

Mean density, occurrence (monthly), abundance and composition presented

**9. Data Evaluation:**

**10. Companion Studies:**

Public Service Electric and Gas 1984

**11. Comments:**

1. **Cited Reference:**  
Public Service Electric and Gas Company. 1984. Salem Generating Station 316(b) Demonstration, Section 2. NPDES permit No. NJ0005622. Prepared by PSE&G, Newark, New Jersey.
  
2. **Principal Investigator:**  
**Name:** Public Service Electric and Gas  
**Address:** 80 Park Plaza  
Newark, NJ 07101  
**Telephone:** (201)621-7500 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, composition and abundance
  
5. **Sample Matrices:**  
Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Examine composition of phytoplankton in vicinity of Salem Generating Station  
**Sample Dates:** **Beginning:** 1973 **End:** 1976  
**Sample Frequency:** 300 samples taken  
**Number of Sampling Stations:** 10

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of the Delaware Bay north to the Burlington-Bristol Bridge (entire Salem study)	0-190	Specific coordinates not given in publication. See Fig. 4.4-1 in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 8.1 liter Van Dorn bottle

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** not given in publication

**Net, sieve, or filter size:** none used

**Other methodologies:**

**Quality control measures:** Seasonally, mean density, occurrence and taxonomic composition presented

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

Public Service Electric and Gas 1980

**11. Comments:**

1. **Cited Reference:**  
 Radiation Management Cooperation and J.E. Edinger Associates, Inc. 1979. An evaluation of the cooling water intake at the Edgemoor Power Station. A Section 316(b) Evaluation. NPDES Permit No. DE-000058. RMC-Ecological Division, Pottstown, PA (Delmarva Power & Light Co.). 116 p.
  
2. **Principal Investigator:**  
**Name:** RMC-Ecological Division  
**Address:** Pottstown, PA  
  
**Telephone:** (215)243-2950 **As of (date):**
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Phytoplankton, chlorophyll a and abundance
  
5. **Sample Matrices:**  
 Water - phytoplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Identify predominant taxa and estimate standing crop, and determine effect of cooling water intake on biological populations.  
**Sample Dates:** **Beginning:** May 1973 **End:** Sept 1975  
**Sample Frequency:** Monthly and semimonthly  
**Number of Sampling Stations:** 11

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Edgemoor Power Station	≈ 72	Specific coordinates not given in publication but shown in Fig. 3.2-1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Van Dorn bottle

**Number of Replicate Samples:** Existence of replicates not mentioned

**Area of Volume per Replicates:** 250 ml aliquots

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Transferred to polyethylene bottles and kept refrigerated and in dark

**8. Data Processing:**

Gives dominant taxa and seasonal trends in abundance

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates 1974; Preddice 1974; Molzahn and Associates 1975; Morrison III and Associates 1976

**11. Comments:**

1. **Cited Reference:**  
Sharp, J.H., T.M. Church and C.H. Culberson. 1980. Data from the 1977 Transx cruises. University of Delaware Oceanographic Data Report Number 1. College of Marine Studies, University of Delaware, Newark, Delaware.
  
2. **Principal Investigator:**  
Name: Jonathan H. Sharp  
Address: University of Delaware  
Lewes, DE  
Telephone: (302)645-4259                      As of (date):
  
3. **Repository of data set or reference:**  
University of Washington, Fisheries-Oceanography Library
  
4. **General Data Type:**  
Parameters measured: Phytoplankton, chlorophyll a, production
  
5. **Sample Matrices:**  
Water - phytoplankton
  
6. **Sampling Design:**  
Purpose of Study: Intended to document the biochemical dynamics and phytoplankton composition and productivity of the Delaware Bay.  
Sample Dates: Beginning: March 9, 1977 End: Sept. 29, 1977  
Sample Frequency: 6 cruises  
Number of Sampling Stations: 4 in Delaware Bay

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay up to Reedy Island vicinity	0-80	B4 38°45'N 74°55'N
		B3 39°03'N 75°12'W
		B2 39°18'N 75°24'W
		B1 39°27'N 75°32'W

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 5-liter Niskin bottle

**Number of Replicate Samples:** none mentioned in publication

**Area of Volume per Replicates:** not given in publication

**Net, sieve, or filter size:** none used

**Other methodologies:**

**Quality control measures:** Used acetone extracts and fluorometric methods of Strickland and Parsons (1972)

**8. Data Processing:**

Paper reports all data collected by station and sampling date

**9. Data Evaluation:**

**10. Companion Studies:**

Pennock 1983; Pennock 1985; Pennock and Sharp 1988;  
Pennock et al. 1983; Culberson 1982; Culberson 1988; Culberson  
et al. 1987a, 1987b, 1987c.

**11. Comments:**

These data not included in Pennock and Sharp 1986

**Reference:**

Strickland, K.D. and T.R. Parsons. 1972. A Practical Handbook of Seawater Analysis. Second Edition. Bull. Fish. Res. Bd. Canada. No. 167. 310 p.

**1. Cited Reference:**

Unrah, F.T. and J.A. Kraut. 1974. Phytoplankton. 19 p. In: An ecological study of the Delaware River in the vicinity of the Edgemoor Power Station. Progress report for the period January through May 1974. Ichthyological Associates, Inc., Wilmington, DE (Delmarva Power & Light Co.) 295 pp.

**2. Principal Investigator:**

**Name:** Timothy L. Preddice, Project Leader

**Address:** Ichthyological Associates, Inc.

c/o Edgemoor Power Station

800 King Street

Wilmington, DE 19899

**Telephone:** (302)378-9881

**As of (date):** Aug 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Phytoplankton, chlorophyll a and abundance

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** To identify dominant phytoplankton genera and provide estimates of standing crop

**Sample Dates:** **Beginning:** Jan 1974 **End:** May 1974

**Sample Frequency:** Once in January, biweekly Feb-May

**Number of Sampling Stations:** 11

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Edgemoor Power Station	70 to 72	Specific coordinates not given in publication but shown in Fig. 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Van Dorn bottle

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:** 250 ml

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Replicate samples analyzed on a Perkin-Elmer Coleman 46 spectrophotometer.

**8. Data Processing:**

Data given for date, station and depth.

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates 1974

**11. Comments:**

Adds to species list from previous Edgemoor study (Ichthyological Associates 1974)

**1. Cited Reference:**

Walton, T.E. III and R. Patrick (eds.). 1973. The Delaware Estuary System Environmental Impacts and Socio-economic Effects: The Delaware River Estuarine Marsh Survey. National Science Foundation, Report No. GI-33369, NSF/RA/E-73-013. 174 p.

**2. Principal Investigator:**

**Name:** Thomas E. Walton, III  
**Address:** University of Delaware  
Newark, DE

**Telephone:**

**As of (date):** 1973

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Phytoplankton, species composition

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** Describe the important marshlands in the Delaware estuary in terms of its aquatic communities and impacts resulting from human activities

**Sample Dates:** **Beginning:** 1970 **End:** 1972

**Sample Frequency:** Summer and Fall 1972

**Number of Sampling Stations:** 154

**Sample Locations:**

General Location	DRBC River km	Coordinates
Marshlands along the entire Delaware estuary and in the river up to Trenton	0 - 212	No specific coordinates given in publication

7. **Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Not given in publication  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
8. **Data Processing:**  
Summary of findings - only dominant and common specific listed
9. **Data Evaluation:**
10. **Companion Studies:**
11. **Comments:**

**1. Cited Reference:**

Watling, L., D. Botton, A. Pembroke and D. Maurer. Seasonal variations in Delaware Bay phytoplankton community structure. Marine Biology. 552:207-215.

**2. Principal Investigator:**

**Name:** Les Watling  
**Address:** Department Oceanography, Ira C. Darling Marine Center  
University of Maine at Orono  
Walpole, ME  
**Telephone:** (207)563-3146 **As of (date):** 1990

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Phytoplankton, abundance

**5. Sample Matrices:**

Water - phytoplankton

**6. Sampling Design:**

**Purpose of Study:** To describe seasonal variations in the Delaware Bay phytoplankton community  
**Sample Dates:** **Beginning:** June 13, 1974 **End:** May 28, 1975  
**Sample Frequency:** Monthly or bimonthly  
**Number of Sampling Stations:** 3

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower bay adjacent to the Mispillion River	≈ 18	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Niskin water bottle sampler, plankton net

**Number of Replicate Samples:** 3 (wholewater), 1 tow

**Area of Volume per Replicates:** 25 mls each

**Net, sieve, or filter size:** #20 mesh

**Other methodologies:**

**Quality control measures:** Data reported for all cruises number of species, total cells per milliliter and species dominants given

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

Botton et al. 1976

**11. Comments:**

## ZOOPLANKTON

1. **Cited Reference:**  
Academy of Natural Sciences of Philadelphia. 1974. Ecological Studies in New Jersey. Oldmans Creek, Raccoon Creek, Birch Creek and Delaware River 1972-1973. Interim Report for Shell-Oil Company. Philadelphia, PA. 406 p.
2. **Principal Investigator:**  
**Name:** Academy of Natural Sciences of Philadelphia  
**Address:** Department of Limnology  
19th and the Parkway  
Philadelphia, PA 19103  
**Telephone:** (215)299-1109 **As of (date):** 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
**Parameters measured:** Zooplankton, taxonomic composition, distribution
5. **Sample Matrices:**  
Water - zooplankton
6. **Sampling Design:**  
**Purpose of Study:** To establish baseline conditions of aquatic life and predict future conditions in the vicinity of the proposed refinery site  
**Sample Dates:** **Beginning:** May 1972 **End:** July 1973  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:** 8

Academy of Natural Sciences of Philadelphia 1974 (cont.)

Sample Locations:

General Location		DRBC River km	Coordinates
DR-1	Mean Little Tinicum Island, NJ side	139	39°51'10" - 75°17'50"
DR-2	Mean Little Tinicum Island, PA side	139	39°50'45" -
DR-3	Transect from Oldmans Creek, PA side	125	79°17'50"
DR-4	Transect from Oldmans Creek, NJ side	124	39°47'30" - 72°26'40"
DR-5	Below Delaware Mem. Bridge, NJ side of channel	106	39°47' - 75°26'15"
DR-6	Below Delaware Mem. Bridge, NJ side of shoal	127	39°41' - 75°31'15"
DR-7	In Delaware River about 1000 yards above Birch Creek	118	39°41' - 75°30'45"
DR-8	Near Wilmington Ferry slip		39°49'45" - 75°22'10"
			39°44' - 75°28'40"

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Plankton net  
  
**Number of Replicate Samples:** Existence of replicate samples not mentioned  
  
**Area of Volume per Replicates:** filtered 50 liters of water  
  
**Net, sieve, or filter size:** #10  
  
**Other methodologies:**  
  
**Quality control measures:**
8. **Data Processing:**  
Summary of species composition
9. **Data Evaluation:**
10. **Companion Studies:**
11. **Comments:**

1. **Cited Reference:**  
Anselmini, L.D. 1974. An ecological study of the Delaware River in the vicinity of Mercer Generating Station, Part 3. Zooplankton. Ichthyological Associates, Inc., Ithaca, New York. (PSE&G)
  
2. **Principal Investigator:**  
**Name:** Ludwig D. Anselmini  
**Address:** Ichthyological Associates  
301 Forest Drive  
Ithaca, New York 14850  
**Telephone:** (607)533-8801 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, abundance, taxonomic composition
  
5. **Sample Matrices:**  
Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Examine the abundance and distribution of zooplankton in the vicinity of Mercer Generating Station  
**Sample Dates:** **Beginning:** 1971 **End:** 1972  
**Sample Frequency:** Biweekly-Monthly  
**Number of Sampling Stations:**

**Sample Locations:** 1

General Location	DRBC River km	Coordinates
Transect from Mercer Generating Station south to transect just above the mouth of Duck Creek	207-210	Specific coordinates not given in publication but shown in Fig. 1

- 7. Sampling Methodologies:** 1971 - .5 m plankton net  
**Sample Gear, Methods and Analyses:** 1972 - Clarke-Bumpus
- Number of Replicate Samples:** Existence of replicate samples  
not mentioned
- Area of Volume per Replicates:**
- Net, sieve, or filter size:** .5 mm mesh #10 (160 micron)
- Other methodologies:**
- Quality control measures:**
- 8. Data Processing:**  
Data presented by station by sampling date
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**

**1. Cited Reference:**

Aurand, D. 1975. Zooplankton in two Delaware estuaries in relation to water quality. Ph.D. diss. University of Delaware, Newark, DE. 240 p.

**2. Principal Investigator:**

**Name:** Don Aurand  
**Address:** University of Delaware  
College of Marine Studies  
Lewes, Delaware

**Telephone:** (302)645-4000

**As of (date):**

**3. Repository of data set or reference:**

University of Delaware, Morris Library, Newark, DE

**4. General Data Type:**

**Parameters measured:** Zooplankton, abundance

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** To evaluate the effects of organic enrichment on estuarine zooplankton using the Broadkill and Murderkill Rivers

**Sample Dates:** **Beginning:** March 1972 **End:** July 1973

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 8

**Sample Locations:**

General Location	DRBC River km	Coordinates
4 stations on Broadkill River (lower and upper estuary, tidal fresh, above and below pollution source)	5	Not given in publication. See Tables 1 and 2.
4 stations on Murderkill River	37	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 30 cm diameter plankton net

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:**  $\approx 1 \text{ m}^3$

**Net, sieve, or filter size:** #20 mesh

**Other methodologies:**

**Quality control measures:** Consecutive vertical tows

**8. Data Processing:**

Data presented by station and sampling date

**9. Data Evaluation:**

**10. Companion Studies:**

Van House 1979

**11. Comments:**

May be able to use as representative of estuarine tributary, before and after study with Van House 1979.

**1. Cited Reference:**

Brewster, M.L. 1974. Abundance and distribution of zooplankton. 47 p. In: An ecological study of the Delaware River in the vicinity of Edgemoor Power Station. Progress report for the period January-May 1974. Ichthyological Associates, Inc., Wilmington, DE. (Delmarva Power and Light Co.)

**2. Principal Investigator:**

**Name:** Timothy L. Preddice, Project Leader  
**Address:** IA, Inc., c/o Edgemoor Power Station  
800 King Street  
Wilmington, DE 19899  
**Telephone:** (302)378-9881

**As of (date):** 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Zooplankton, abundance

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** Determine seasonal, tidal and diurnal abundance and distribution of zooplankton in the Delaware River in the vicinity of EMPS.

**Sample Dates:** Beginning: January 1974c End: May 1974

**Sample Frequency:** Biweekly-Monthly

**Number of Sampling Stations:** 6

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Edgemoor Power Station	70-72	Specific coordinates not given in publication but shown in Fig. 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Plankton pump with plankton net

**Number of Replicate Samples:** Not given in report

**Area of Volume per Replicates:** .5m<sup>3</sup>

**Net, sieve, or filter size:** 80 micron mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Results given for each sampling period, monthly and bimonthly mean densities

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates 1974a, 1974b

**11. Comments:**

**1. Cited Reference:**  
Cronin, L.E. 1954. Plankton Studies. Bienn. Rpt. University of Delaware Marine Laboratory. (1953-1954), Publ. 2:16-20.

**2. Principal Investigator:**  
**Name:** L. Eugene Cronin  
**Address:** University of Delaware,  
College of Marine Studies  
Lewes, Delaware  
**Telephone:** (302)645-4000

**As of (date):**

**3. Repository of data set or reference:**  
Versar, Inc., Columbia, MD

**4. General Data Type:**  
**Parameters measured:** Zooplankton, volume, distribution,  
species abundance

**5. Sample Matrices:**  
Water - zooplankton

**6. Sampling Design:**  
**Purpose of Study:** Organized to measure and interpret the zooplankton crop in an estuary, from marine saltwater to freshwater.  
**Sample Dates:** **Beginning:** Fall 1951 **End:** Winter 1953  
**Sample Frequency:** Seasonally (quarterly)  
**Number of Sampling Stations:** 19

**Sample Locations:**

General Location	DRBC River km	Coordinates
Overfalls, lightship at the mouth of Delaware Bay to Philadelphia	0-162	Specific coordinates not given in publication but shown in Fig. 7.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Clarke-Bumpus plankton sampler

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** Net towed @ 3 knots for 1 hour

**Net, sieve, or filter size:** #2 silk nets

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Presented seasonally

**9. Data Evaluation:**

**10. Companion Studies:**

Cronin et al. 1960

**11. Comments:**

**1. Cited Reference:**

Cronin, L.E., J.C. Daiber and E.M. Hulburt. 1962. Quantitative seasonal aspects of zooplankton in the Delaware River. Ches. Sci. 3(2):63-93.

**2. Principal Investigator:**

Name: L.E. Cronin  
Address: University of Delaware

Telephone: (302)645-4000

As of (date):

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

Parameters measured: Zooplankton, volume, abundance

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** Present a detailed description of the standing crops of zooplankton in the Delaware coastal plain estuary.

**Sample Dates:** Beginning: Dec 1951 End: Aug 1953

**Sample Frequency:** Seasonal

**Number of Sampling Stations:** 13

**Sample Locations:**

General Location	DRBC River km	Coordinates
Within 40 ft. dredged channel from Overfalls Lightship to Philadelphia	0-162	Specific coordination not given in publication

**7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Clarke-Bumpus sampler

Number of Replicate Samples: 1

Area of Volume per Replicates: 35-40 m<sup>3</sup>

Net, sieve, or filter size: #2 nets

Other methodologies:

Quality control measures: Simultaneous sampling

**8. Data Processing:**  
Results presented seasonally

**9. Data Evaluation:**

**10. Companion Studies:**  
Cronin 1954

**11. Comments:**

1. **Cited Reference:**  
 Daiber, F.C., L.L. Thornton, K.A. Bolster, T.G. Campbell, O.W. Crichton, G.L. Exposito, D.R. Jones and J.M. Tyrawski. 1976. An Atlas of Delaware's Wetlands and Estuarine Resources. Technical Report No. 2. Delaware Coastal Management Program. College of Marine Studies, University of Delaware, Newark, Delaware. 528 p.
  
2. **Principal Investigator:**  
**Name:** Larry Thornton, Technical Director  
**Address:** Delaware Wetland and Water Resources Atlas Project  
 College of Marine Studies  
 Newark, DE  
**Telephone:** (302)645-4000 **As of (date):**
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, taxonomic distribution
  
5. **Sample Matrices:**  
 Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Indicate some of the important zooplankton species in the Delaware estuary, seasonal distributions and population fluctuations  
**Sample Dates:** **Beginning:** N/A **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of the Delaware Bay to Wilmington	0-120	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** N/A, used literature to 1976

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

Deevey 1960; Cronin et al. 1962; Delaware Ecological Survey 1973; Ichthyological Associates (1970-1973)

**11. Comments:**

Compiles and summarizes many previous studies on zooplankton in the Delaware Bay. Shows seasonal differences in distribution.

**1. Cited Reference:**

Deevey, G.B. 1960. The zooplankton of the surface waters of the Delaware Bay region. Bull. Bingham Oceanogr. Collect. 17:5-53.

**2. Principal Investigator:**

Name: Georgiana B. Deevey

Address:

Telephone:

As of (date):

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

Parameters measured: Zooplankton, abundance, volume

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** To show variations in abundance and species composition of zooplankton in an area (middle Atlantic) in which no general survey has been done.

**Sample Dates:** Beginning: 1929 End: 1935 (data available 30-33)

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 3

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware from the mouth at Overfalls Lightship to Brandywine Shoal	0 to 16	Specific coordinates not given in publication but shown in Fig. 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Net 1 m in diameter

**Number of Replicate Samples:** Not given in report

**Area of Volume per Replicates:** 10-min. tows, 5-min. surface, 5-min. subsurface

**Net, sieve, or filter size:** Possibly #0 or #2 silk

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Presented monthly, relative percentages and periods of occurrence

**9. Data Evaluation:**

**10. Companion Studies:**

Augmented by Cronin 1954; Cronin et al. 1960

**11. Comments:**

Nets were coarse, therefore nauplii copepodite stages and smaller species were caught only when net clogged. Only larger species caught in true proportion. Only valid for surface and subsurface forms. Bottom forms also not caught in true proportion. Zooplankton numbers somewhat lower in 1931 and 1932.

**1. Cited Reference:**

Dittel, A.I. and C.E. Epifanio. 1983. Seasonal abundance and vertical distribution of crab larvae in Delaware Bay. Estuaries. 5:197-202.

**2. Principal Investigator:**

Name: A.I. Dittel  
Address: College of Marine Studies  
University of Delaware  
Lewes, DE 19958

Telephone: (302)645-4000 As of (date): Sept 1982

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

Parameters measured: Zooplankton, abundance, blue crab larvae

**5. Sample Matrices:**

Water - blue crab larvae

**6. Sampling Design:**

Purpose of Study: Determine abundance and seasonal occurrence of blue crab larvae

Sample Dates: Beginning: May 26, 1978 End: Oct. 28, 1978

Sample Frequency: Once every 3 weeks

Number of Sampling Stations: 1

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay	0	38°51.6'N 75° .4° 15.0'W

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 30 m Clarke-Bumpus

**Number of Replicate Samples:** Not given in report

**Area of Volume per Replicates:** Not given in report

**Net, sieve, or filter size:** #6 nylon, 243  $\mu\text{m}$  aperture

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Seasonal abundance by sampling date, total number collected given by relative abundance of larval stage by depth. Maximum larval concentrations.

**9. Data Evaluation:**

**10. Companion Studies:**

Dittel 1980

**11. Comments:**

1. **Cited Reference:**  
Epifanio, C.E., C.C. Valenti, and A.E. Pembroke. 1984. Dispersal and Recruitment of Blue Crab Larvae in Delaware Bay, USA. Estuarine, Coastal and Shelf Science. 18:1-12.
  
2. **Principal Investigator:**  
**Name:** C.E. Epifanio  
**Address:** College of Marine Studies  
University of Delaware  
Lewes, DE 19958  
**Telephone:** (302)645-4000 **As of (date):** 1984
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, abundance and distribution
  
5. **Sample Matrices:**  
Water - blue crab larvae
  
6. **Sampling Design:**  
**Purpose of Study:** Determine the degree of retention of blue crab larvae in the Delaware estuary.  
**Sample Dates:** **Beginning:** July 1979 **End:** Sept. 1981  
**Sample Frequency:** Weekly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay	0	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** .3 m Clarke-Bumpus plankton sampler

**Number of Replicate Samples:** not given in publication

**Area of Volume per Replicates:** 5-10 m<sup>3</sup>

**Net, sieve, or filter size:** 243  $\mu$ m (#6)

**Other methodologies:**

**Quality control measures:** Samples subdivided with a Folsom plankton splitter (Dittel and Epifanio 1982)

**8. Data Processing:**

By sampling date and station

**9. Data Evaluation:**

**10. Companion Studies:**

Dittel and Epifanio 1982

**11. Comments:**

**1. Cited Reference:**

Ferrante, J.G. 1971. A quantitative study of the zooplankton in the Delaware River in the vicinity of Artificial Island. 41 p. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Progress report for the period January-December 1970, Part II. Ichthyological Associates, Middletown, DE.

**2. Principal Investigator:**

**Name:** Edward C. Raney, Ph.D., Director

**Address:** Ichthyological Associates

301 Forest Drive

Ithaca, NY 14850

**Telephone:** (607)533-8801

**As of (date):** 1971

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Zooplankton, distribution, abundance

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** Discuss the distribution and abundance of zooplankton near Artificial Island in 1971

**Sample Dates:** Beginning: Jan. 1970 End: Dec. 1970

**Sample Frequency:** Biweekly

**Number of Sampling Stations:** 8

**Sample Locations:**

General Location	DRBC River km	Coordinates
From just below Salem Generating Station to the Chesapeake and Delaware Canal	73 to 86	Specific coordinates not given in publication but shown in Fig. 1

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** 5 in. diameter Clarke-Bumpus  
  
**Number of Replicate Samples:** 2  
  
**Area of Volume per Replicates:** Not given in publication  
  
**Net, sieve, or filter size:** .5 mm mesh  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**  
Results presented in monthly summary
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Ichthyological Associates 1980; Lindsay 1974; Lindsay and Morrisson 1974
- 11. Comments:**

1. **Cited Reference:**  
Herman, S.S. and B.R. Hargreaves. 1988. First order estimate of secondary productivity in the Delaware Estuary. 8 p. In: Ecology and Restoration of the Delaware River Basin (Majumdar, S.K., E.W. Miller and L.E. Sage, eds.). The Pennsylvania Academy of Science.
  
2. **Principal Investigator:**  
**Name:** Sidney S. Herman  
**Address:** Department of Biology  
 Lehigh University  
 Bethlehem, PA 18015  
**Telephone:** (215)758-3692 **As of (date):** 1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, abundance and biomass
  
5. **Sample Matrices:**  
Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Used literature to summarize zooplankton production in Delaware estuary  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
From the mouth of Delaware Bay to the mouth of Red Lion Creek	0 to 100	Specific coordinates not given in publication

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: N/A  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Summary of existing literature
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Deevey 1960; Cronin et al. 1962; Maurer et al. 1978;  
Ichthyological Associates 1980
- 11. Comments:**

**1. Cited Reference:**

Herman, S.S., B.R. Hargreaves, R.A. Lutz, L.W. Fritz and C.E. Epifanio. 1983. Zooplankton and parameters. 9 p. In: The Delaware Estuary: Research as Background for Estuarine Management and Development (Sharp, ed.). University of Delaware and New Jersey Marine Sciences Consortium, Lewes, Delaware.  
326 p.

**2. Principal Investigator:**

**Name:** Jonathan H. Sharp  
**Address:** University of Delaware  
Lewes, DE 19958  
**Telephone:** (302)645-4259 **As of (date):** 12/1990

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Zooplankton, density and biomass

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** Identify most important zooplankton species study their population dynamics and underlying forces that determine population size.

**Sample Dates:** **Beginning:** May 1982 **End:** 1983

**Sample Frequency:** Semimonthly

**Number of Sampling Stations:** 9

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Trenton, NJ	0 to 212	Specific coordinates not given in publication but shown in Fig. 11-2

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: 1/2 meter net  
  
Number of Replicate Samples: 2  
  
Area of Volume per Replicates: measured by flowmeter  
  
Net, sieve, or filter size: #10 net  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Monthly abundances (density) and biomass given
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Deevey 1960; Cronin et al. 1962; Maurer et al. 1978
- 11. Comments:**

1. **Cited Reference:**  
Hulburt, E.M. 1957. The distribution of *Neomysis americana* in the estuary of the Delaware River. Limnol. Oceanog. 2:1-11.
2. **Principal Investigator:**  
Name: Edward M. Hulburt  
Address:  
  
Telephone: \_\_\_\_\_ As of (date): \_\_\_\_\_
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:** Mysids  
**Parameters measured:** Density, zooplankton abundance
5. **Sample Matrices:**  
Water - zooplankton
6. **Sampling Design:**  
**Purpose of Study:** Describe the distribution of *Neomysis americana* in the Delaware estuary  
**Sample Dates:** Beginning: Oct. 1951 End: August 1953  
**Sample Frequency:** Seasonal  
**Number of Sampling Stations:** 4 transects and up the channel

**Sample Locations:**

General Location	DRBC River km	Coordinates
See Fig. 1 (p. 2). Mouth of Delaware Bay to Philadelphia	0 to 160	Specific coordinates not given in publication but shown in Fig. 1

**7. Sampling Methodologies:**

Sample Gear, Methods and Analyses: 5 in. Clarke-Bumpus

Number of Replicate Samples: not given in publication

Area of Volume per Replicates: 20-50 m<sup>3</sup>

Net, sieve, or filter size: #2 silk net

Other methodologies:

Quality control measures:

**8. Data Processing:**

Mysid data presented for each cruise, each station

**9. Data Evaluation:**

**10. Companion Studies:**

Cronin et al. 1962

**11. Comments:**

**1. Cited Reference:**

Ichthyological Associates, Inc. 1974. An ecological study of the Delaware River in the vicinity of Edgemoor Power Station Progress Report for October-December 1973. Ichthyological Associates, Inc., Wilmington, DE. (Delmarva Power and Light Co.) 109 p.

**2. Principal Investigator:**

**Name:** Edward C. Raney, Ph.D., Director  
**Address:** Ichthyological Associates, Inc.  
301 Forest Drive  
Ithaca, NY 14850

**Telephone:** (607)533-8801

**As of (date):** Feb. 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Zooplankton, samples not complete

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** To estimate abundance of zooplankton in the Delaware River in the vicinity of Edgemoor Power Station

**Sample Dates:** **Beginning:** 10 Oct 1973 **End:** 23 Dec 1973

**Sample Frequency:** Biweekly

**Number of Sampling Stations:** 6

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Edgemoor Power Station	≈ 70-72	Specific coordinates not given in publication but shown in Figs. 10 and 11

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Plankton pump filter system

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:**  $1/2 \text{ m}^3$

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Not processed

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates 1971b

**11. Comments:**

1. **Cited Reference:**  
 Ichthyological Associates, Inc. 1979. A study of ichthyoplankton and macrozooplankton entrained in the cooling water intake canal at the Getty Delaware City, Delaware Facility, September 1977-August 1978. A Report to Getty Marketing and Refining Co. Delaware City, Delaware. 58 p.
  
2. **Principal Investigator:**  
**Name:** Edward C. Raney  
**Address:** Ichthyological Associates, Inc.  
 301 Forest Drive  
 Ithaca, New York 14850  
**Telephone:** (607)533-8801 **As of (date):** 1979
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:** Mysids  
**Parameters measured:** Density, taxa, temporal occurrence, zooplankton composition, abundance and distribution
  
5. **Sample Matrices:**  
 Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Estimate total number and seasonal occurrence of mysids and *Gammarus* entrained in the Getty Marketing and Refining Co. Delaware City Refinery intake canal.  
**Sample Dates:** **Beginning:** Sept 1977 **End:** Aug 1978  
**Sample Frequency:** Biweekly-Monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Intake canal at Getty's Delaware City Refinery	≈ 101	Specific coordinates not given in publication

**7. Sampling Methodologies:**

Sample Gear, Methods and Analyses: 1/2 m plankton net

Number of Replicate Samples: 2

Area of Volume per Replicates: Not given in report

Net, sieve, or filter size: .5 mm mesh

Other methodologies:

Quality control measures:

**8. Data Processing:**

Seasonal-monthly

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

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**1. Cited Reference:**

Lambert, R. and A. Pembroke. 1976. Zooplankton. 40 p. In: Ecological Studies on Benthic and Planktonic Assemblages in Lower Delaware Bay (L. Watling and D. Mauer, eds.) NSF/RANN.

**2. Principal Investigator:**

**Name:** Les Watling and Don Maurer, editors

**Address:** College of Marine Studies  
University of Delaware  
Lewes, DE 19958

**Telephone:** (302)645-4000 **As of (date):** 1976

**3. Repository of data set or reference:**

University of Delaware, Morris Laboratory

**4. General Data Type:**

**Parameters measured:** Zooplankton abundance and composition

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** Examine cycles of zooplankton species and determine qualitative and or quantitative differences between them.

**Sample Dates:** **Beginning:** June 1974 **End:** May 1975

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 3

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lightening area, lower Delaware Bay adjacent to Mispillion River	≈ 18	Specific coordinates not given in publication

7. **Sampling Methodologies:**  
Sample Gear, Methods and Analyses: 30 cm diameter Clarke-Bumpus  
  
Number of Replicate Samples: 2  
  
Area of Volume per Replicates: not given in publication  
  
Net, sieve, or filter size: #6  
  
Other methodologies:  
  
Quality control measures:
8. **Data Processing:**  
Monthly densities given
9. **Data Evaluation:**
10. **Companion Studies:**  
Later published as Maurer et al. 1978.
11. **Comments:**

**1. Cited Reference:**

Lindsay, J.H. 1974. A study of zooplankton in the Delaware River in the vicinity of Artificial Island in 1971. 47 p. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Ichthyological Associates, Inc., Middletown, DE 210 p.

**2. Principal Investigator:**

Name: V.J. Schuler, M.S. Project Leader  
Address: Ichthyological Associates, Inc.  
100 S. Cass Street  
Middletown, DE 19709

Telephone: (302)378-9881

As of (date):

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

Parameters measured: Zooplankton, abundance

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

Purpose of Study: To make quantitative and qualitative faunal measurements, and to discuss food drain importance and spatial distribution.

Sample Dates: Beginning: July 1971 End: Dec 1971

Sample Frequency: Biweekly

Number of Sampling Stations: 19

**Sample Locations:**

General Location	DRBC River km	Coordinates
Smyrna River to Chesapeake and Delaware Canal	71 to 94	Specific coordinates not given in publication but shown in Fig. 1

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** 5 in. Clarke-Bumpus
  - Number of Replicate Samples:** Not given in publication
  - Area of Volume per Replicates:** 1.5 m<sup>3</sup> water filtered
  - Net, sieve, or filter size:** #20 net
  - Other methodologies:**
  - Quality control measures:**
- 8. Data Processing:**
  - Data presented monthly by station
- 9. Data Evaluation:**
- 10. Companion Studies:**
  - Ichthyological Associates 1980; Lindsay and Morrisson 1974;  
Ferrante 1971
- 11. Comments:**

**1. Cited Reference:**

Lindsay, J.H. and N.J. Morrisson, III. 1974. A study of zooplankton. 74 p. In: An ecological study of the Delaware River in the vicinity of Artificial island. Ichthyological Associates, Inc., Middletown, DE. 746 p.

**2. Principal Investigator:**

**Name:** V.J. Schuler, M.S., Project Leader

**Address:** Ichthyological Associates, Inc.  
100 S. Cass Street  
Middletown, DE 19709

**Telephone:** (302)378-9881

**As of (date):** 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Zooplankton, abundance

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** To make quantitative and qualitative faunal measurement, and to discuss seasonal and diurnal fluctuations with major emphasis on important species group.

**Sample Dates:** **Beginning:** Jan 1972 **End:** Dec 1972

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 13

**Sample Locations:**

General Location	DRBC River km	Coordinates
Smyrna River and Chesapeake and Delaware Canal	71 to 94	Specific coordinates not given in publication but shown in Fig. 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Clarke-Bumpus plankton sampler

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** #20 nets (.08 mm mesh)

**Other methodologies:**

**Quality control measures:** Simultaneous samples

**8. Data Processing:**

Monthly results given mean densities for '71 and '72, results given per sampling period

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates 1980; Lindsay 1974; Ferrante 1971

**11. Comments:**

1. **Cited Reference:**  
Maurer, D. 1974a. Biological condition of the deep-water portion of lower Delaware Bay. Lewes Field Station, Lewes, Delaware. Grant No. GI 33369, NSF-RANN. 94 p.
2. **Principal Investigator:**  
Name: Don Maurer  
Address: CA State University Long Beach  
So CA Ocean Study Consortium  
Long Beach, CA 90840  
Telephone: (213)985-7874 As of (date): 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Zooplankton, abundance and seasonal distribution
5. **Sample Matrices:**  
Water - zooplankton
6. **Sampling Design:**  
Purpose of Study: Discuss zooplankton dominance, and species distribution based upon previous studies  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Chesapeake and Delaware Canal	0 - 94	Specific coordinates not given in report. Refer to Fig. 1

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Used literature  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Yearly and seasonal results of previous studies presented
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Ferrante 1971; Deevey 1960; Cronin et al. 1962; Hulburt 1957;  
Price 1962
- 11. Comments:**

1. **Cited Reference:**  
Maurer, D. 1974b. Impacts of a deepwater terminal: Volume I, Environmental problems associated with a deepwater port in the Delaware Bay area. Philadelphia Academy of Natural Sciences, the University of Delaware, and Rutgers University. Grant No. GI 33369, NSF-RANN. 206 pp.
  
2. **Principal Investigator:**  
Name: Don Maurer  
Address: CA State University Long Beach  
So CA Ocean Study Consortium  
Long Beach, CA 90840  
Telephone: (213)985-7874 As of (date): 1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Zooplankton, abundance and seasonal distribution
  
5. **Sample Matrices:**  
Water - zooplankton
  
6. **Sampling Design:**  
Purpose of Study: Discuss zooplankton dominance and species distribution based upon previous studies.  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of the Delaware Bay to Chesapeake and Delaware Canal	0 to 94	Specific coordinates not given in report

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Used literature  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Yearly and seasonal results of previous studies presented
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Ferrante 1971; Deevey 1960; Cronin et al. 1962; Hulburt 1957;  
Price 1962
- 11. Comments:**

1. **Cited Reference:**  
Maurer, D.L., Watling, R. Lambert, and A. Pembroke. 1978.  
Seasonal fluctuation of zooplankton populations in lower Delaware Bay. *Hydrobiologia*.61:149-160.
  
2. **Principal Investigator:**  
Name: Don Maurer  
Address: CA State University Long Beach  
So CA Ocean Study Consortium  
Long Beach, CA 90840  
Telephone: (213)985-7874 As of (date): 1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Zooplankton-abundance
  
5. **Sample Matrices:**  
Water - zooplankton
  
6. **Sampling Design:**  
Purpose of Study: Determine seasonal fluctuation of zooplankton populations in the lower Delaware Bay.  
Sample Dates: Beginning: June 1974 End: May 1975  
Sample Frequency: Monthly or bimonthly, 15 cruises  
Number of Sampling Stations: 3

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Bay - adjacent to Mispillion River	≈ 18	Specific coordinates not given in publication. See Figure 1.

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Clarke-Bumpus plankton sampler 30 cm. diameter
- Number of Replicate Samples: 2
- Area of Volume per Replicates: Not given
- Net, sieve, or filter size: No. 6 (0.241 mm) net
- Other methodologies:
- Quality control measures: Tows were approximately 15 minutes.
- 8. Data Processing:**  
Yearly and seasonal results of previous studies presented
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Ferrante 1971  
Deevey 1960  
Cronin et al. 1962
- 11. Comments:**  
This paper was published earlier as Lambert and Pembroke 1976.

1. **Cited Reference:**  
Nixon, S.W. 1983. Estuarine ecology -- A comparative and experimental analysis using 14 estuaries and the MERL microcosms. Final report to the U.S. Environmental Protection Agency, Chesapeake Bay Program.
  
2. **Principal Investigator:**  
**Name:** Scott W. Nixon  
**Address:** Graduate School Oceanography  
University of Rhode Island  
Narragansett, RI 02882  
**Telephone:** (401)792-6258 **As of (date):** 12/1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, abundance
  
5. **Sample Matrices:**  
Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Review of previous studies from 19 estuaries including the Delaware. Only highly summarized data presented.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware Bay	Not given	Not given

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Not given

Number of Replicate Samples:

Area of Volume per Replicates:

Net, sieve, or filter size:

Other methodologies:

Quality control measures:
- 8. Data Processing:**  
Shows 1 yearly (by month) cycle
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Culberson et al. 1982; Maurer and Wang 1973; Sharp 1980;  
Watling and Maurer 1976
- 11. Comments:**

1. **Cited Reference:**  
 Preddice, T.L. 1974. The occurrence, abundance, and distribution of larval crabs in the vicinity of Artificial Island, Delaware River. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Progress Report for the period January-December 1972. V.J. Schuler, M.S., Project Leader. Ichthyological Associates, Inc., Middletown, Delaware. 746 p.
  
2. **Principal Investigator:**  
**Name:** V.J. Schuler  
**Address:** Ichthyological Associates, Inc.  
 100 S. Cass Street  
 Middletown, DE 19709  
**Telephone:** (302)378-9881 **As of (date):**
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, abundance, composition and distribution
  
5. **Sample Matrices:**  
 Water - larval crabs
  
6. **Sampling Design:**  
**Purpose of Study:** Discuss occurrence, abundance and distribution of larval crabs in the Delaware River near Artificial Island.  
**Sample Dates:** **Beginning:** June 1971 **End:** Oct 1972  
**Sample Frequency:** Biweekly  
**Number of Sampling Stations:** 11

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Salem Nuclear Generating Station approximately 10 km upstream and 10 km downstream	≈ 70-96	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 1/2 in. diameter plankton net

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** Existence of replicate samples not mentioned

**Net, sieve, or filter size:** .5 mm

**Other methodologies:**

**Quality control measures:** Simultaneous samples

**8. Data Processing:**

Summary of abundances given by sampling date and station

**9. Data Evaluation:**

**10. Companion Studies:**

Arndt 1974; Arndt and Meadows 1974; Smith 1974; Connelly 1974

**11. Comments:**

1. **Cited Reference:**  
Public Service Electric and Gas (Company). 1980. An Ecological Study of the Delaware River near Artificial Island, 1968-1976: A summary. PSE&G, Newark, New Jersey.
2. **Principal Investigator:**  
Name: Ichthyological Associates, Inc.  
Address: Dr. Edward C. Raney  
Middletown, DE 19709  
Telephone: (302)378-9881 As of (date): 1980
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Zooplankton, taxonomic composition and abundance
5. **Sample Matrices:**  
Water - zooplankton
6. **Sampling Design:**  
Purpose of Study: Examine the taxonomy and density of zooplankton in the Delaware River near Artificial Island.  
Sample Dates: Beginning: 1968 End: 1976  
Sample Frequency: Monthly to biweekly  
Number of Sampling Stations: 22

**Sample Locations:**

General Location	DRBC River km	Coordinates
Woodland Beach to Pea Patch Island	66 to 96	Specific coordinates not given in publication but shown in Fig. 31

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Pump filter system (Icanberry and Richardson, 1972) and Clarke-Bumpus plankton sampler

**Number of Replicate Samples:** Not given in publication

**Area of Volume per Replicates:** Not given in publication

**Net, sieve, or filter size:** .08 mm mesh net

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Densities expressed in yearly reports - not in this report. Presents monthly data for 1973-1976.

**9. Data Evaluation:**

**10. Companion Studies:**

Lindsay 1974; Lindsay and Morrisson 1974; PSE&G 1984; Ferrante 1971

**11. Comments:**

Use synopsis in back of report. Good discussion of population dynamics and importance in Delaware River method standardized for 1973-1976, variable methods 1968-1972. First 1/2 m net, .5 mm mesh the Clarke-Bumpus used (.08 m mesh).

1. **Cited Reference:**  
Public Service Electric and Gas (PSE&G). 1984a. Salem Generating Station 316(b) Demonstration, Section 2 and 7. NPDES permit No. NJ0005622. Prepared by PSE&G, Newark, New Jersey.
2. **Principal Investigator:**  
Name: Public Service Electric and Gas  
Address: 80 Park Plaza  
Newark, NJ  
Telephone: (201)621-7500 As of (date): 1984
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Zooplankton, distribution and population dynamics
5. **Sample Matrices:**  
Water - zooplankton
6. **Sampling Design:**  
Purpose of Study: See Companion Study  
Sample Dates: Beginning: 1973 End: 1980  
Sample Frequency: 2,332 collections  
Number of Sampling Stations: 22

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware estuary near Salem Generating Station	64-97	Specific coordinates not given in report

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Pump filter system  
(Icanberry and Richardson 1972) Clarke-Bumpus plankton sampler

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** Not mentioned

**Net, sieve, or filter size:** .08 mm

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summary of research

**9. Data Evaluation:**

**10. Companion Studies:**

Public Service Electric and Gas 1980

**11. Comments:**

1. **Cited Reference:**  
Public Service Electric and Gas Company. 1984b. *Neomysis americana*: A synthesis of information on natural history with reference to occurrence in the Delaware River and estuary and involvement with the Salem Generating Station. Salem Generating Station 316(b) Demonstration, Appendix II.
  
2. **Principal Investigator:**  
**Name:** Public Service Electric and Gas Company  
**Address:** 80 Park Plaza  
Newark, NJ 07101  
**Telephone:** (201)621-7500 **As of (date):** 1984
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton distribution and abundance--Mysids
  
5. **Sample Matrices:**  
Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** As a target species for the Salem 316(b) Demonstration, technical information on the species and its use of the Delaware River and estuary (and aspects of involvement with Salem) is presented.  
**Sample Dates: Beginning:** 1977 **End:** 1980  
**Sample Frequency:** Not given in this report  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Information from entire estuary and density estimates from vicinity of Salem Nuclear Generating Station	64-97	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Pump filter system (Icanberry and Richardson 1972) and Clarke-Bumpus sampler

**Number of Replicate Samples:** Not given

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** .08 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summary presented -- distribution, average densities

**9. Data Evaluation:**

**10. Companion Studies:**

Public Service Electric and Gas Co. 1984a, 1984c

**11. Comments:**

Excellent description of role in estuary, good for justification. Use densities to make graph (yearly average). Biology is beyond scope.

1. **Cited Reference:**  
Radiation Management Cooperation and J.E. Edinger Associates, Inc. 1979. An evaluation of the cooling water intake at the Edgemoor Power Station. A Section 316(b) Evaluation. NPDES Permit No. DE-000058. RMC-Ecological Division, Pottstown, PA. (Delmarva Power and Light Co.). 116 pp.
  
2. **Principal Investigator:**  
**Name:** Radiation Management Cooperation  
**Address:** Ecological Division  
Pottstown, PA  
**Telephone:** (215)243-2950 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, abundance
  
5. **Sample Matrices:**  
Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** To describe spatial distribution and abundance of zooplankton near Edgemoor Power Station.  
**Sample Dates:** Beginning: Oct 1973 End: Sept 1975  
**Sample Frequency:** Semi-monthly, monthly and 24-hr weekly  
**Number of Sampling Stations:** 6

**Sample Locations:**

General Location	DRBC River km	Coordinates
2.4 km south of Edgemoor Power Station to 2.7 km north of Edgemoor Power Station	≈ 110-115	Specific coordinates not given in publication but shown in Fig. 3.3-1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** (Entrainment) centrifugal suction pump

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** .5 m<sup>3</sup>

**Net, sieve, or filter size:** 80 micron mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Data presented for all dates sampled at all stations

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates, Inc. 1974; Preddice 1974; Molzahn and Associates 1975; Morrison and Associates 1976

**11. Comments:**

1. **Cited Reference:**  
 Van House, M.P. 1979. A reexamination of the zooplankton community of a Delaware tidal stream. M.S. Thesis. University of Delaware, Newark, DE. 96 p.
  
2. **Principal Investigator:**  
**Name:** Mary Patricia Van House  
**Address:** University of Delaware  
 College of Marine Studies  
 Lewes, Delaware  
**Telephone:** (302)645-4000 **As of (date):**
  
3. **Repository of data set or reference:**  
 University of Delaware, Morris Library, Newark, DE
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton, abundance
  
5. **Sample Matrices:**  
 Water - zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** To test the hypothesis that changes in an estuary's water quality will be reflected by changes in its zooplankton community.  
**Sample Dates:** **Beginning:** Oct 1978 **End:** Dec 1979  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:** 4

**Sample Locations:**

General Location	DRBC River km	Coordinates
4 stations on Murderkill (above and below pollution input, upper and lower estuary)	37	Specific coordinates not given in thesis

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Standard 30 cm diameter plankton nets  
  
Number of Replicate Samples: 2  
  
Area of Volume per Replicates:  $\approx 1 \text{ m}^3$   
  
Net, sieve, or filter size: #20 mesh  
  
Other methodologies:  
  
Quality control measures: Consecutive vertical tows
- 8. Data Processing:**
- 9. Data Evaluation:**  
Data presented by station and sampling date
- 10. Companion Studies:**  
Aurand 1975
- 11. Comments:**  
This study is similar to that of Aurand 1975. Thus, a comparison may be made between 1974 data and 1978-1979 data.

**1. Cited Reference:**

Walton, T.E., III and R. Patrick (eds.). 1973. The Delaware Estuary System. Environmental Impacts and Socio-economic Effects: The Delaware River Estuarine Marsh Survey. National Science Foundation. Report No. GI-33369. NSF/RA/E-73-013. 174 p.

**2. Principal Investigator:**

**Name:** Thomas E. Walton, III  
**Address:** University of Delaware  
Newark, DE

**Telephone:** (302)645-4000 **As of (date):** 1973

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Zooplankton, species composition

**5. Sample Matrices:**

Water - zooplankton

**6. Sampling Design:**

**Purpose of Study:** Describe the important marshlands in the Delaware estuary in terms of its aquatic communities and impacts resulting from human activities.

**Sample Dates:** **Beginning:** 1970 **End:** 1972

**Sample Frequency:** Summer and Fall 1972

**Number of Sampling Stations:** 154

**Sample Locations:**

General Location	DRBC River km	Coordinates
Marshlands along the entire Delaware estuary and in the river up to Trenton	0-212	No specific coordinates given in publication

**7. Sampling Methodologies:**

Sample Gear, Methods and Analyses: Not given

Number of Replicate Samples:

Area of Volume per Replicates:

Net, sieve, or filter size:

Other methodologies:

Quality control measures:

**8. Data Processing:**

Summary of findings for dominant and common species

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

## ICHTHYOPLANKTON

1. **Cited Reference:**  
Anselmini, L.D. 1974. An Ecological Study of the Delaware River in the Vicinity of Mercer Generating Station, Part 2, Ichthyoplankton. Ichthyological Associates, Inc., Ithaca, New York. 615 p.
2. **Principal Investigator:**  
**Name:** L.D. Anselmini  
**Address:** Ichthyological Associates, Inc.  
Ithaca, New York  
**Telephone:** \_\_\_\_\_ **As of (date):** 1974
3. **Repository of data set or reference:**  
Versar Inc., Columbia, MD
4. **General Data Type:**  
**Parameters measured:** Zooplankton - ichthyoplankton abundance and distribution
5. **Sample Matrices:**  
Water-zooplankton
6. **Sampling Design:**  
**Purpose of Study:** Determine the abundance and distribution of ichthyoplankton in the Delaware River in the vicinity of Mercer Generating Station.

**Sample Dates:** Beginning: April 1971 End: July 1973  
**Sample Frequency:** Variable  
**Number of Sampling Stations:** 1 zone

**Sample Locations:**

General Location	DRBC River km	Coordinates
Vicinity of Mercer Generating Station	207 - 210	No specific coordinates given in publication. See Figure 1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 1/2 meter plankton net

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 0.5 mm mesh nylon .

**Other methodologies:** 5 to 15 minute tows with TSK-USA flow meter used to calculate volume filtered

**Quality control measures:**

**8. Data Processing:** Data presented by sampling date and station. Cumulative taxonomic list of ichthyoplankton presented.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
 Biosystems Analysis, Inc. 1990. Results of an ichthyoplankton and juvenile fish survey conducted near the Keystone Cogeneration project site, April-August 1990. Tiburon, CA. (Prepared for Bechtel)
  
2. **Principal Investigator:**  
**Name:** Biosystems Analysis, Inc.  
**Address:** 3152 Paradise Drive  
 Tiburon, CA 94920  
**Telephone:** **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton distribution, abundance, taxonomic composition - ichthyoplankton
  
5. **Sample Matrices:**  
 Water-zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Provide suitable data for predicting the impact of the proposed project on the ichthyoplankton and juvenile fish in the vicinity of the Keystone Project.  
**Sample Dates:** **Beginning:** April 1990 **End:** July 1990  
**Sample Frequency:** Weekly and biweekly  
**Number of Sampling Stations:** 3 transects

**Sample Locations:**

General Location	DRBC River km	Coordinates
One transect near Keystone (close to Marcus Hook), 1 transect above Commodore Barry Bridge and the third 3-4 km below Keystone.	~ 77 - 85	Specific coordinates not given in publication but shown in Figure 1.

**7. Sampling Methodologies:**

Sample Gear, Methods and Analyses: Bongo nets

Number of Replicate Samples: 2

Area of Volume per Replicates: Not given

Net, sieve, or filter size: 333  $\mu\text{m}$  and 505  $\mu\text{m}$

Other methodologies:

Quality control measures: Simultaneous samples to account for extension and avoidance (replicate tows).

**8. Data Processing:**

Data presented by sampling date and transect

**9. Data Evaluation:**

**10. Companion Studies:**

Weisberg and Burton 1989

Academy of Natural Sciences of Philadelphia 1974

**11. Comments:**

**1. Cited Reference:**

Harmon, P.L. and D.C. Smith. 1975. An ecological study of the Delaware River in the vicinity of Eddystone Generating Station. Eddystone Progress Report No. 4. Ichthyological Associates, Inc., Pottstown, PA. (Philadelphia Electric Co.)

**2. Principal Investigator:**

**Name:** Edward C. Raney  
**Address:** Ichthyological Associates, Inc.  
301 Forest Drive  
Ithaca, New York 14850

**Telephone:** (607)533-8801

**As of (date):**

**3. Repository of data set or reference:**

Ichthyological Assoc. (Incomplete reference at Versar)

**4. General Data Type:**

**Parameters measured:** Zooplankton abundance, taxonomic composition - ichthyoplankton

**5. Sample Matrices:**

Water-zooplankton

**6. Sampling Design:**

**Purpose of Study:** Determine abundance of ichthyoplankton in the vicinity of Eddystone Generating Station

**Sample Dates:** Beginning: Jan 1974 End: Dec 1974

**Sample Frequency:** Weekly -- monthly

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Vicinity of Eddystone Generating Station	~ 135	Specific coordinates not given in publication

**7. Sampling Methodologies:**

Sample Gear, Methods and Analyses: .5 m plankton net

Number of Replicate Samples: Existence of replicate samples not mentioned

Area of Volume per Replicates:

Net, sieve, or filter size: .5 mm mesh

Other methodologies:

Quality control measures:

**8. Data Processing:**

By sampling date and station

**9. Data Evaluation:**

**10. Companion Studies:**

Potter et al. 1974b

**11. Comments:**

1. **Cited Reference:**  
Himchak, P.J. 1982. Monitoring of the spring ichthyoplankton in the Delaware River, April 1981 through March 1982. Technical Report Series 82-2. New Jersey Dept. Environmental Protection, Division of Fish, Game and Wildlife, Marine Fisheries Administration. Project. F-15-R--23.

2. **Principal Investigator:**  
Name: Peter J. Hemchak  
Address:

Telephone: \_\_\_\_\_ As of (date): \_\_\_\_\_

3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland

4. **General Data Type:**  
Parameters measured: Zooplankton abundance -  
ichthyoplankton

5. **Sample Matrices:**  
Water-zooplankton

6. **Sampling Design:**  
**Purpose of Study:** Attempt to assess striped bass production in the Delaware River.  
**Sample Dates:** Beginning: Spring 1981 End: Spring 1981  
**Sample Frequency:** Daily for 10 days  
**Number of Sampling Stations:** 6 segments

**Sample Locations:**

General Location	DRBC River km	Coordinates
Reedy Island, NJ to Trenton, NJ	86 - 212	Specific coordinates not given in publication

**7. Sampling Methodologies:**

Sample Gear, Methods and Analyses: 20 cm bongo nets

Number of Replicate Samples: 2

Area of Volume per Replicates: 50 m<sup>3</sup> (water filtered)

Net, sieve, or filter size: 505 mesh

Other methodologies:

Quality control measures:

**8. Data Processing:**

Provides relative abundance estimates for all ichthyoplankton.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Johnson, R.K. and T.S. Koo. 1975. Production and distribution of striped bass (*Morone saxatilis*) eggs in the Chesapeake and Delaware Canal. Ches. Sci. 16:39-55.
2. **Principal Investigator:**  
Name: Robert K. Johnson  
Address: Division of Fishes, Field Museum of Natural History  
Chicago, IL 60605  
Telephone: \_\_\_\_\_ As of (date): 1975
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Zooplankton abundance and distribution
5. **Sample Matrices:**  
Water-zooplankton
6. **Sampling Design:**  
Purpose of Study: Determine production and distribution of fish eggs and larvae with respect to season, location within the system and physical parameters.  
Sample Dates: Beginning: March 31, 1971 End: Dec 1972  
Sample Frequency: Variable/weekly  
Number of Sampling Stations: 2

**Sample Locations:**

General Location	DRBC River km	Coordinates
Two stations adjacent to the C&D canal (many stations in the canal and more in the Chesapeake Bay)	~ 96	Specific coordinates not given in publication but shown in Figure 1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Plankton net 24" diameter

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:**  $94.5 \pm 2.5 \text{ m}^3/\text{tow}$

**Net, sieve, or filter size:** (plankton mesh) not given

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Cumulative catch

**9. Data Evaluation:**

**10. Companion Studies:**

Mansueti 1958

**11. Comments:**

**1. Cited Reference:**

Kernehan, R.J., M.R. Headrick, and R.E. Smith. 1981. Early life history of striped bass in the Chesapeake and Delaware Canal and Vicinity. Trans. Am. Fish. Soc. 110:137-150.

**2. Principal Investigator:**

**Name:** R.J. Kernehan  
**Address:** Delmarva Ecological Lab  
Middletown, DE

**Telephone:** \_\_\_\_\_ **As of (date):** \_\_\_\_\_

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Zooplankton abundance -  
ichthyoplankton

**5. Sample Matrices:**

Water-zooplankton

**6. Sampling Design:**

**Purpose of Study:** Describe spawning characteristics, distribution of early life stages, and factors that may affect year class strength.

**Sample Dates:** Beginning: 1973 End: 1977

**Sample Frequency:** \_\_\_\_\_

**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
C&D canal (east)	~ 94	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Ichthyoplankton tows, midwater trawls, inshore bottom trawls, seine collections

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** ichthyoplankton - .505 mm mesh

**Other methodologies:**

**Quality control measures:** Sample volumes measured with digital flowmeter

**8. Data Processing:**

Gives densities of egg, larval and net flow through the C&D canal is west to east and that, therefore, the majority of the ichthyoplankton is being transported through the canal and released into the Delaware River in areas that may not be important spawning or nursery areas.

**9. Data Evaluation:**

**10. Companion Studies:**

1973-1977 Ecological studies in the vicinity of the proposed Summit Power Station. Prepared by the Delmarva Ecological Lab for Delmarva Power & Light, Wilmington, DE

**11. Comments:**

1. **Cited Reference:**  
Murawski, W.S. 1969. The distribution of striped bass, *Roccus saxatalis*, eggs and larvae in the lower Delaware River. Miscellaneous Report No. 1M. Project F-15-R. New Jersey Department of Conservation and Economic Development, Trenton, NJ. 35 p.
  
2. **Principal Investigator:**  
**Name:** Walter S. Murawski  
**Address:** Nacote Creek Research Station  
  
**Telephone:** \_\_\_\_\_ **As of (date):** 1969
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton abundance  
ichthyoplankton
  
5. **Sample Matrices:**  
Water-zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Locate spawning area of striped bass in the Delaware River and determine the periodicity of spawning and water conditions under which developing eggs and larvae occurred.  
**Sample Dates:** **Beginning:** 1962 **End:** 1966  
**Sample Frequency:** \_\_\_\_\_  
**Number of Sampling Stations:** 15

## Sample Locations:

General Location	DRBC River km	Coordinates
Reedy Island	85	Buoy 6R
Oakwood Beach, NJ	92	Buoy 2N
Fort Mott State Park, NJ	96	Buoy 6N
Kilkahook Wildlife Refuge, NJ	101	Buoy 4D
Delaware Memorial Bridge, NJ	110	Beacon
Penns Grove, NJ	116	Ferry Pier
Oldman's Point	122	Buoy 8
Bridgeport, NJ	129	Buoy E
Westville, NJ	150	Buoy 48
Riverton, NJ	174	Buoy 12
Burlington, NJ (see Fig. 1)	190	200 yds. upstream from Burlington Bristol Bridge
Florence, NJ	196	Buoy 63
Newbold Island	204	Buoy 72
Bordentown, NJ	207	Buoy 90
Trenton, NJ	213	Buoy 107

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** .5 m plankton nets

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** .95 mm

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summary of distribution of location of striped bass eggs and larvae.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

**1. Cited Reference:**  
 Potter, W.A., D.C. Smith, and P.L. Harmon. 1974a. An Ecological Study of the Delaware River in the vicinity of Chester Generating Station, Chester Progress Report No. 1 for the period March-December 1973. Ichthyological Associates, Inc., Pottstown, PA. (Philadelphia Electric Co.)

**2. Principal Investigator:**  
**Name:** Edward C. Raney  
**Address:** Ichthyological Assoc. Inc.  
 301 Forest Drive  
 Ithaca, NY 14850  
**Telephone:** (607)533-8801

**As of (date):**

**3. Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland

**4. General Data Type:**  
**Parameters measured:** Zooplankton abundance, taxonomic composition - ichthyoplankton

**5. Sample Matrices:**  
 Water-zooplankton

**6. Sampling Design:**  
**Purpose of Study:** Examine abundance of ichthyoplankton in the vicinity of Chester Generating Station.  
**Sample Dates:** **Beginning:** March 1973 **End:** Dec 1973  
**Sample Frequency:** Semi-monthly - monthly, weekly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Vicinity of Chester Generating Station	~ 140	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** .5 m plankton net

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** .5 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

By sampling date and station

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Potter, W.A., D.C. Smith, and P.L. Harmon. 1974b. An ecological study of the Delaware River in the vicinity of Eddystone Generating Station, Eddystone Progress Report No. 3, for the period January-December 1973. IA, Inc., Pottstown, PA. (Philadelphia Electric Co.)
  
2. **Principal Investigator:**  
Name: Edward C. Raney  
Address: IA, Inc.  
301 Forest Drive  
Ithaca, NY 14850  
Telephone: (607)533-8801 As of (date): 1974
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Zooplankton abundance -  
ichthyoplankton
  
5. **Sample Matrices:**  
Water-zooplankton
  
6. **Sampling Design:**  
Purpose of Study: Examine abundance and distribution of ichthyoplankton in the vicinity of Eddystone Generating Plant.  
Sample Dates: Beginning: June 1973 End: August 1973  
Sample Frequency: Weekly to semi-monthly  
Number of Sampling Stations: 9

**Sample Locations:**

General Location	DRBC River km	Coordinates
Vicinity of Eddystone Generating Station	135	Specific coordinates not given in publication but shown in Table 2

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** .5 plankton net

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** Not mentioned

**Net, sieve, or filter size:** .5 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summary of abundance and number of species (individuals) collected in 1973.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
RMC Environmental Services. 1989. A study of striped bass eggs and larvae and other ichthyoplankton in the Delaware River near Edge Moor Power Station in 1989. RMC Environmental Services, Pottstown, Pennsylvania (Delmarva Power and Light).
  
2. **Principal Investigator:**  
**Name:** RMC Environmental Services  
**Address:** Fricks Lock Road  
R.D. 1  
Pottstown, PA 19464  
**Telephone:** (215)326-9662 **As of (date):** Sept 1989
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton abundance - zooplankton
  
5. **Sample Matrices:**  
Water-zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Evaluate the present extent of use of the Delaware River in the vicinity of Edge Moor Power Station as spawning and nursery grounds for striped bass.  
**Sample Dates:** **Beginning:** 5 April 1989 **End:** 15 June 1989  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
At Edge Moor Power Station	~ 72	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 50 cm diameter bongo nets

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** 100-150 m<sup>3</sup> water-sampled (for both nets)

**Net, sieve, or filter size:** .5 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Gives abundance, spatial distribution and densities of ichthyoplankton for each sample date and station.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Wang, C.S. 1974. A study of fish eggs larvae and young. 83 p.  
In: An ecological study of the Delaware River in the vicinity of  
Artificial Island, Progress Report for the Period January-December  
1971. V.J. Schuler, M.S., Project Leader. Ichthyological  
Associates, Inc., Middletown, Delaware. 709 p.
  
2. **Principal Investigator:**  
**Name:** V.J. Schuler  
**Address:** Ichthyological Associates, Inc.  
100 S., Cass Street  
Middletown, DE 19709  
**Telephone:** (302)378-9881 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton abundance, taxonomic  
composition ichthyoplankton
  
5. **Sample Matrices:**  
Water-zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Identify and determine the spatial and  
seasonal distribution of ichthyoplankton  
**Sample Dates:** **Beginning:** May 1971 **End:** Dec 1971  
**Sample Frequency:** Variable  
**Number of Sampling Stations:** 9

**Sample Locations:**

General Location	DRBC River km	Coordinates
From the mouth of Alloway Creek (in the river) to a transect across from Delaware Point. See Fig. 1, p. 382.	~ 72 - 86	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 1/2 m plankton nets and 9 ft semi balloon trawl

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** .5 mm mesh

**Other methodologies:**

**Quality control measures:** Simultaneous samples

**8. Data Processing:**

Monthly data presented by sampling date and station

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Weisberg, S.B. and W. Burton. 1988. Spatial and temporal patterns of striped bass spawning activity in the Delaware River during spring 1988. Versar, Inc., Columbia, Maryland.
  
2. **Principal Investigator:**  
**Name:** Versar, Inc.  
**Address:** 9200 Rumsey Road  
Columbia, MD 21045  
**Telephone:** (301)964-9200 **As of (date):** 1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton abundance  
ichthyoplankton
  
5. **Sample Matrices:**  
Water-zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Determine spatial and temporal distribution of striped bass eggs and larvae in the Delaware River and its major tributaries  
**Sample Dates:** Beginning: Apr 1988 End: June 1988  
**Sample Frequency:** Weekly  
**Number of Sampling Stations:** 6 random stations and 9 regions

**Sample Locations:**

General Location	DRBC River km	Coordinates
From Salem Nuclear Power Plant and 4 tributaries: Oldmans Creek, Raccoon Creek, Christina River, Schuylkill River, and C&D Canal to Trenton, New Jersey	93 - 240	Specific coordinates not given in publication but shown in Figure II-1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Epibenthic ichthyoplankton sled and .5 m bongo nets

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** 250 m<sup>3</sup> (filtered)

**Net, sieve, or filter size:** 505  $\mu$ m mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Per region per sampling date

**9. Data Evaluation:**

**10. Companion Studies:**

Weisberg et al. 1987

**11. Comments:**

**1. Cited Reference:**

Weisberg, S.B., W.H. Burton, R.W. Chapman, and P.F. Kazyak.  
1987. Striped bass spawning and stock assessment in the  
Delaware River between Philadelphia, PA and Trenton, NJ.  
Versar, Inc., Columbia, Maryland.

**2. Principal Investigator:**

**Name:** Stephen B. Weisberg  
**Address:** Versar, Inc.  
9200 Rumsey Road  
Columbia, Maryland 21045

**Telephone:** (301)964-9200

**As of (date):** 1990

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Zooplankton densities, taxonomic  
composition ichthyoplankton

**5. Sample Matrices:**

Water-zooplankton

**6. Sampling Design:**

**Purpose of Study:** Assess current status of striped bass in the  
Delaware River

**Sample Dates:** **Beginning:** April 22, 1987 **End:** June  
23, 1987

**Sample Frequency:** Weekly

**Number of Sampling Stations:** 6 zones

**Sample Locations:**

General Location	DRBC River km	Coordinates
From Trenton to mouth of Delaware Bay	Zone 1 - N/A 2 - 174- 214 3 - 153- 174 4 - 127- 153 5 - 78- 127 6 - 0-78	

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Epibenthic sled, .5 m bongo nets
- Number of Replicate Samples:** Existence of replicate samples not mentioned
- Area of Volume per Replicates:** Not given
- Net, sieve, or filter size:** 250 m<sup>3</sup> 150 m<sup>3</sup>
- Other methodologies:** 505 μm mesh
- Quality control measures:**
- 8. Data Processing:**  
 Summary of collections for spring
- 9. Data Evaluation:**
- 10. Companion Studies:**  
 Murawaski 1969
- 11. Comments:**

1. **Cited Reference:**  
Weisberg, S.B., W.H. Burton, J. Gurley, and A. Brindley. 1990. Early life stage survival of striped bass from the Delaware River, with particular reference to the Presidenté Rivera oil spill.
  
2. **Principal Investigator:**  
**Name:** Stephen B. Weisberg  
**Address:** Versar, Inc.  
9200 Rumsey Road  
Columbia, Maryland 21045  
**Telephone:** (301)964-9200 **As of (date):** 1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Zooplankton ichthyoplankton survival
  
5. **Sample Matrices:**  
Water-zooplankton
  
6. **Sampling Design:**  
**Purpose of Study:** Evaluate likelihood of water quality to be sufficient to support survival of striped bass larvae in the Delaware River.  
**Sample Dates:** Beginning: April 1989 End: July 1989  
**Sample Frequency:** 4 *in situ* tests  
**Number of Sampling Stations:** 5

**Sample Locations:**

General Location	DRBC River km	Coordinates
From the Delaware Memorial Bridge to south Tinicum Island south	110 - 137	Specific coordinates not given in publication but shown in Figure II-2

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** 75 liter chambers with 23 x 134 cm flow-thru mesh windows
- Number of Replicate Samples:** 2
- Area of Volume per Replicates:** 75 liter
- Net, sieve, or filter size:** Not given
- Other methodologies:** Control chambers on shore with well water in them
- Quality control measures:**
- 8. Data Processing:**
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Weisberg et al. 1987  
Weisberg and Burton 1989
- 11. Comments:**

**1. Cited Reference:**

Wik, J.D., and N.J. Morrisson, III. 1974. A study of fish eggs larvae and young. 33 p. In: An ecological study of the Delaware River in the vicinity of Edge Moor Power Station Progress Report January-May 1974. Ichthyological Associates, Inc., Wilmington, DE (Delmarva Power and Light).

**2. Principal Investigator:**

Name: Timothy L. Preddice

Address: Ichthyological Assoc. Inc.  
Wilmington, DE

Telephone: (302)378-9881

As of (date): 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

Parameters measured: Zooplankton abundance and distribution  
ichthyoplankton

**5. Sample Matrices:**

Water-zooplankton

**6. Sampling Design:**

Purpose of Study: Determine season, tidal and diurnal abundance and distribution of larval fish and eggs in the study area

Sample Dates: Beginning: Jan 1974 End: May 1974

Sample Frequency: Biweekly

Number of Sampling Stations: 6 zones

**Sample Locations:**

General Location	DRBC River km	Coordinates
Portion of Delaware that extends 2.6 km north and 2.4 km south of Edge Moor power station in the Delaware River	~ 69 - 75	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** .5 m plankton net

**Number of Replicate Samples:** Existence of replicate samples  
not mentioned

**Area of Volume per Replicates:** Not mentioned

**Net, sieve, or filter size:** .5 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates 1974

**11. Comments:**

**BENTHOS**

1. **Cited Reference:**  
Academy of Natural Sciences of Philadelphia. 1974. Ecological Studies in New Jersey, Oldmans Creek, Raccoon Creek, Birch Creek and Delaware River 1972-1973. Interim Report for Shell Oil Company. Philadelphia. PA. 406 p.
2. **Principal Investigator:**  
**Name:** Academy of Natural Sciences of Philadelphia  
**Address:** Department of Limnology  
19th and the Parkway  
Philadelphia, PA 19103  
**Telephone:** (215)299-1109 **As of (date):** 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
**Parameters measured:** Benthic species composition and abundance
5. **Sample Matrices:**  
Sediment-Benthic Community
6. **Sampling Design:**  
**Purpose of Study:** Establish baseline for aquatic life in the vicinity of a proposed refinery site  
**Sample Dates:** **Beginning:** May 1972 **End:** July 1973  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:** 8

**Sample Locations:**

General Location	DRBC River km	Coordinates
DR-1 - mean Little Tinicum Island, NJ side	139	39° 51'10" - 75° 17'50"
DR-2 - opposite DR-1	139	39° 50'45" - 79° 17'50"
DR-3 - transect from Oldmans Creek, PA side	125	39° 47'30" - 72° 26'40"
DR-4 - transect from Oldmans Creek, PA side	124	39° 47' - 75° 26'15"
DR-5 - Below Del. Mem. Bridge, NJ side of channel	106	39° 41' - 75° 31' 15"
DR-6 - Below Del. Mem. Bridge, NJ side of channel	106	39° 41' - 75° 30' 45"
DR-7 - in Del R. about 1,000 yards above Birch Creek	127	39 °49'45" - 75° 22'10"
DR8 - near Wilmington Ferry slip	118	39° 44' - 75° 28'40"

**7. Sampling Methodologies:****Sample Gear, Methods and Analyses:**

Peterson grab, Eckman dredge, oyster trawl and fish trawl

**Number of Replicate Samples:****Area of Volume per Replicates:****Net, sieve, or filter size:** Not given**Other methodologies:****Quality control measures:**

8. **Data Processing:**  
Summary of dominant species given
9. **Data Evaluation:**
10. **Companion Studies:**
11. **Comments:**

1. **Cited Reference:**  
Anselmini, L.D. 1974. An Ecological Study of the Delaware River in the Vicinity of Mercer Generating Station, Part 4, Benthos. Ichthyological Associates, Inc., Ithaca, New York. (PSE&G)
  
2. **Principal Investigator:**  
**Name:** Ludwig D. Anselmini  
**Address:** Ichthyological Associates, Inc.  
301 Forest Drive  
Ithaca, New York 14850  
**Telephone:** (607)533-8801 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic taxonomic composition and abundance
  
5. **Sample Matrices:**  
Sediment - Benthic Community
  
6. **Sampling Design:**  
**Purpose of Study:** Examine the abundance and distribution of zooplankton in the vicinity of Mercer Generating Station  
**Sample Dates:** **Beginning:** June 1971 **End:** Oct 1973  
**Sample Frequency:**  
**Number of Sampling Stations:** 1 zone

**Sample Locations:**

General Location	DRBC River km	Coordinates
Below Duck Island south about 1.5 km	207.5 - 209	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Peterson grab and Ponar grab

**Number of Replicate Samples:** Not given in publication

**Area of Volume per Replicates:** Not given in publication

**Net, sieve, or filter size:** No. 18 (1.0 x 1.0 mm) and No. 35 (.5 x .5 mm)

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Data presented in publication by date and station.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

**1. Cited Reference:**

Arndt, R.G. 1974. The biology and economics of the blue crab, *Callinectes sapidus*, in the Delaware River near Artificial Island. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Progress Report for the Period January-December 1971. V.J. Schuler, M.S., Project Leader. Ichthyological Associates, Inc., Middletown, Delaware. 709 p.

**2. Principal Investigator:**

**Name:** V.J. Schuler, Project Leader  
**Address:** Ichthyological Associates, Inc.  
.100 S. Cass Street  
Middletown, DE 19709

**Telephone:** (302)378-9881 **As of (date):**

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic abundance blue crab only

**5. Sample Matrices:**

Sediment-Benthic Community

**6. Sampling Design:**

**Purpose of Study:** Collate and compare data from the commercial catch with data from the biological sampling program

**Sample Dates:** Beginning: Jan 1971 End: Dec 1971

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Approximately 9 km upriver and 9 km downriver of the Salem Nuclear Generating Station	~ 70 - 98	Specific coordination not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 16 ft semi-balloon Otter trawl and 9 ft otter trawl

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summary of commercial catch by sampling date and station

**9. Data Evaluation:**

**10. Companion Studies:**

Smith 1974

Smith 1974

Arndt and Meadows 1974

Connelly 1974

**11. Comments:**

1. **Cited Reference:**  
 Arndt, R.G., and R.E. Meadows. 1974. The biology and economics of the blue crab, *Callinectes sapidus*, in the Delaware River in the vicinity of Artificial Island. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Progress Report for the Period January-December 1972. V.J. Schuyler, M.S., Project Leader. Ichthyological Associates, Inc., Middletown, Delaware. 746 p.
  
2. **Principal Investigator:**  
**Name:** Victor J. Schuler  
**Address:** Ichthyological Associates, Inc.  
 100 S. Cass St.  
 Middletown, DE 19709  
**Telephone:** (302)378-9881 **As of (date):**
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance, blue crab only
  
5. **Sample Matrices:**  
 Sediment-Benthic Community
  
6. **Sampling Design:**  
**Purpose of Study:** Define biological and economic status of the blue crab in the upper Delaware estuary  
**Sample Dates:** **Beginning:** Jan 1972 **End:** Dec 1972  
**Sample Frequency:** Variable  
**Number of Sampling Stations:** 32

**Sample Locations:**

General Location	DRBC River km	Coordinates
Approximately 10 km upriver to 10 km downriver of the Salem Nuclear Generating Station	~ 70-98	Specific coordination not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Otter trawls, seines, commercial pots

**Number of Replicate Samples:** Not given in publication

**Area of Volume per Replicates:** Not given in publication

**Net, sieve, or filter size:** Not given

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summary of commercial fishery by sampling date and station.

**9. Data Evaluation:**

**10. Companion Studies:**

Smith 1974  
Schuler 1974  
Connelly 1974  
Arndt 1974

**11. Comments:**

1. **Cited Reference:**  
 Botton, M.L. 1982. Predation by adult horseshoe crabs, *Limulus polyphemus* (L.), and its effect on benthic intertidal community structure of breeding beaches in Delaware Bay, New Jersey. Ph.D. diss. Rutgers University, New Brunswick, New Jersey. 466 pp
  
2. **Principal Investigator:**  
**Name:** Mark Lewis Botton  
**Address:** Excel Division  
 Fordham University  
 College at Lincoln Center  
 New York, NY  
  
**Telephone:** \_\_\_\_\_ **As of (date):** 1990
  
3. **Repository of data set or reference:**  
 Rutgers University, Library of Science and Medicine
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance
  
5. **Sample Matrices:**  
 Sediment-Benthic Communities
  
6. **Sampling Design:**  
**Purpose of Study:** Estimate size of *Limulus* population and study predator -- prey relationships  
**Sample Dates:** Beginning: May 1977 End: June 1980  
**Sample Frequency:** Yearly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
On the beach south of Rutgers Oyster Research Lab	~ 38	No specific coordinates given in publication

**7. Sampling Methodologies:**

Sample Gear, Methods and Analyses: Counts of *Limulus* on the beaches

Number of Replicate Samples: N/A

Area of Volume per Replicates: N/A

Net, sieve, or filter size: N/A

Other methodologies: N/A

Quality control measures: N/A

**8. Data Processing:**

Data presented by yearly sampling dates

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
 Botton, M.L. 1984a. The importance of predation by horseshoe crab, *Limulus polyphemus*, to an intertidal sand flat community. J. Mar. Res. 42:139-161.
  
2. **Principal Investigator:**  
**Name:** Mark L. Botton  
**Address:** Excel Division  
 Fordham University  
 College at Lincoln Center  
 New York, New York  
  
**Telephone:** \_\_\_\_\_ **As of (date):** 1990
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance
  
5. **Sample Matrices:**  
 Sediment-Benthic Community
  
6. **Sampling Design:**  
**Purpose of Study:** Examine the effect of *Limulus* exclusion on an intertidal invertebrate assemblage  
**Sample Dates:** Beginning: 1978 End: 1979  
**Sample Frequency:** Variable during field seasons  
**Number of Sampling Stations:** 1 Beach zone

**Sample Locations:**

General Location	DRBC River km	Coordinates
Area adjoining Oyster Research Laboratory up to 2 km south	~ 38	No specific coordinates given in this publication

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** "Stranded" animals on beach counted  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
8. **Data Processing:**  
Data presented by sampling date
9. **Data Evaluation:**
10. **Companion Studies:**  
Botton 1984b
11. **Comments:**  
Demonstration that *Limulus* is an important predator of *Gemma gemma*, *Mulinia lateralis*, and *Mya arenaria*.

1. **Cited Reference:**  
 Botton, M.L. 1984b. Diet and food preferences of the adult horseshoe crab *Limulus polyphemus* in Delaware Bay. Mar. Bio. 81:199-207.
  
2. **Principal Investigator:**  
 Name: Mark L. Botton  
 Address: Excel Div.  
 Fordham University  
 College at Lincoln Center  
 New York, New York 10023  
 Telephone: \_\_\_\_\_ As of (date): 1990
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
 Parameters measured: Benthic-*Limulus* food preference
  
5. **Sample Matrices:**  
 Sediment-Benthic Community
  
6. **Sampling Design:**  
 Purpose of Study: Describe and examine the food habits of *Limulus polyphemus* in the context of selective feeding  
 Sample Dates: Beginning: May 1978 End: Aug 1979  
 Sample Frequency: Summer collections  
 Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Vicinity of New Jersey Oyster Research Lab	~ 38	No specific coordinates given in publication

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Hand collected on beach  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
  
8. **Data Processing:**  
Total number of food items by species preference by length of crab and prey.
  
9. **Data Evaluation:**
  
10. **Companion Studies:**  
Botton 1984a
  
11. **Comments:**

1. **Cited Reference:**  
Bousfield, E.L. 1969. *New records of Gammarus*  
(Crustacea:Amphipoda) from the middle Atlantic region. Ches.  
Sci. 10:1-17.
2. **Principal Investigator:**  
Name: E.L. Bousfield  
Address:  
  
Telephone: \_\_\_\_\_ As of (date): \_\_\_\_\_
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Benthic-amphipod distribution
5. **Sample Matrices:**  
Sediment-benthic communities
6. **Sampling Design:**  
Purpose of Study: Tells some distribution of *Gammarus* and gives  
a key to middle Atlantic species of *Gammarus*  
Sample Dates: Beginning: \_\_\_\_\_ End: \_\_\_\_\_  
Sample Frequency: Used literature  
Number of Sampling Stations: \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
No specific location given in publication	No specific location given in publication	No coordinates given in publication

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** N/A, used literature Cronin et al. 1962  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
  
- 8. Data Processing:**  
Given distribution and ecology of amphipod species based upon previous published data.
  
- 9. Data Evaluation:**
  
- 10. Companion Studies:**  
Cronin et al. 1962
  
- 11. Comments:**  
Presents list of amphipod species found in Delaware Bay

1. **Cited Reference:**  
 Connelly, R.A. 1974. A quantitative study of benthic macroinvertebrates in the vicinity of Artificial Island. 70p. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Ichthyological Associates. 746 p.
  
2. **Principal Investigator:**  
**Name:** Victor J. Schuler  
**Address:** Ichthyological Associates, Inc.  
 100 S. Cass St.  
 Middletown, Delaware 19709  
**Telephone:** (302)378-9881 **As of (date):**
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance and biomass
  
5. **Sample Matrices:**  
 Sediment-benthic communities
  
6. **Sampling Design:**  
**Purpose of Study:** To estimate species diversity, abundance, distribution and biomass on basis of sampling systematically.  
**Sample Dates:** **Beginning:** Jan 1972 **End:** Dec 1972  
**Sample Frequency:**  
**Number of Sampling Stations:** 30

**Sample Locations:**

General Location	DRBC River km	Coordinates
From the Smyrna River To Chesapeake and Delaware Canal	70 - 96	Specific coordination not given in publication but shown in Figure 1

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Ponar grab

Number of Replicate Samples: 3

Area of Volume per Replicates: .05 m<sup>2</sup> to depth 15 cm

Net, sieve, or filter size: #35 .5mm mesh

Other methodologies:

Quality control measures:
- 8. Data Processing:**  
Data collected given by date and by station. Monthly and yearly biomass and density presented
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Smith 1974  
Ichthyological Associates 1980
- 11. Comments:**  
Use with companion studies for complete picture of monitoring around Artificial Island.

1. **Cited Reference:**  
Crumb, S.E. 1977. Macrobenthos of the tidal Delaware River between Trenton and Burlington, New Jersey. Ches. Sci. 18:253-265.
  
2. **Principal Investigator:**  
**Name:** Stephen E. Crumb  
**Address:** Ichthyological Associates, Inc.  
 Box 286  
 Louwood Grove Rd  
 R.D. 1,  
 Middletown, DE 19709  
**Telephone:** (302)378-9881 **As of (date):** 1977
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthos abundance, biomass,  
 taxonomic diversity
  
5. **Sample Matrices:**  
Sediment-benthic community
  
6. **Sampling Design:**  
**Purpose of Study:** Describe the spatial and temporal components of the benthic communities from Trenton to Burlington, New Jersey.  
**Sample Dates:** **Beginning:** Aug 1971 **End:** Oct 1973  
**Sample Frequency:** Monthly, weather permitting  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Tidal Delaware River from Burlington to Trenton	≈ 210 - 217	Specific coordination not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Ponar grab, Peterson grab

**Number of Replicate Samples:** Existence of replicates not mentioned

**Area of Volume per Replicates:** (.23 x .23 m) (.30 x .30 m)

**Net, sieve, or filter size:** #8 (1 x 1 mm) and #35 (.5 x .5 mm)

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summary of all species collected and density by month

**9. Data Evaluation:**

**10. Companion Studies:**

Fuller and Powell 1973 (ref. only)

**11. Comments:**

One of the few benthic studies in this region of the Delaware Estuary.

1. **Cited Reference:**  
Curtis, L.A. 1973. Aspects of the life cycle of *Sabellaria vulgaris* Venill (Polychaeta: *Sabellaridae*) in Delaware Bay Estuaries. 1:73-84.
  
2. **Principal Investigator:**  
Name: Lawrence A. Curtis  
Address:  
  
Telephone: \_\_\_\_\_ As of (date): \_\_\_\_\_
  
3. **Repository of data set or reference:**  
University of Delaware, Morris Library, Newark
  
4. **General Data Type:**  
Parameters measured: Benthic abundance
  
5. **Sample Matrices:**  
Sediment-benthic community
  
6. **Sampling Design:**  
Purpose of Study: Examine life cycle of *Sabellaria vulgaris*  
Sample Dates: Beginning: \_\_\_\_\_ End: \_\_\_\_\_  
Sample Frequency: \_\_\_\_\_  
Number of Sampling Stations: 14

**Sample Locations:**

General Location	DRBC River km	Coordinates
From Mispellion River jetty to south Bowers Beach	19 - 33	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Asbestos shingles for settling plates

**Number of Replicate Samples:** None

**Area of Volume per Replicates:** None

**Net, sieve, or filter size:** None

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study of the population dynamics of one polychaete species is too specific for general descriptions of status and trends.

1. **Cited Reference:**  
 Daiber, F.C., L.L. Thornton, K.A. Bolster, T.G. Campbell, O.W. Crichton, G.L. Exposito, D.R. Jones and J.M. Tyrawski. 1976. An Atlas of Delaware's Wetlands and Estuarine Resources. Tech. Rpt. No. 2, Delaware Coastal Management Program. College of Marine Studies, University of Delaware, Newark, DE. 528 p.
  
2. **Principal Investigator:**  
**Name:** Franklin C. Daiber  
**Address:** University of Delaware  
  
**Telephone:** (302)451-2977 **As of (date):** 1990
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance and distribution
  
5. **Sample Matrices:**  
 Sediment-benthic community
  
6. **Sampling Design:**  
**Purpose of Study:** Describes environmental parameters of estuarine wildlife species and gives information about adult and juvenile populations, spawning areas, habits, and occurrences.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:** Used literature  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
The Delaware estuary mouth of the bay up to and beyond Wilmington, DE	0 - 130	Specific coordination not given in publication

7. **Sampling Methodologies:**  
Sample Gear, Methods and Analyses: N/A  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
8. **Data Processing:**  
N/A
9. **Data Evaluation:**
10. **Companion Studies:**
11. **Comments:**  
Gives general description of populations of oyster crabs and hard clams, including distribution and environmental requirements and current status of populations.

1. **Cited Reference:**  
Haskin, H. 1978. Final Report to the Delaware River and Bay Authority on the effects of overboard soil disposal from Cape May Ferry Terminal on the Biota of Lower Delaware Bay. Delaware River and Bay Authority.
  
2. **Principal Investigator:**  
**Name:** Harold H. Haskins  
**Address:** Rutgers Shellfish Laboratory  
Port Norris, New Jersey  
**Telephone:** (609)785-0074 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Rutgers University, Library of Science and Medicine, New Brunswick, New Jersey
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance and distribution
  
5. **Sample Matrices:**  
Sediment-benthos
  
6. **Sampling Design:**  
**Purpose of Study:** Discuss observations on benthic communities and populations in the disposal site after disposal occurred.  
**Sample Dates:** Beginning: Nov 1971 End: July 1973  
**Sample Frequency:** Seasonally, before and after disposal  
**Number of Sampling Stations:** 16

**Sample Locations:**

General Location	DRBC River km	Coordinates
Off coast of Cape May Point in the Delaware Bay within the Bay shore channel	~ 0 - 10	Specific coordination not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Peterson grab and 30 in oyster dredge

**Number of Replicate Samples:** 2 to 6

**Area of Volume per Replicates:** .07 m<sup>2</sup>

**Net, sieve, or filter size:** 1-2 mm screens

**Other methodologies:**

**Quality control measures:** 30 inch oyster dredged towed for 2 minutes to ensure larger area coverage in tally of epifaunal species.

**8. Data Processing:**

Monthly data presented in publication.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Study shows population dynamics of benthic community at the mouth of Delaware Bay.

**1. Cited Reference:**

Haskin, H.H., R.A. Lutz and C.E. Epifanio. 1983. Benthos (shellfish). 24 p. In: The Delaware estuary: Research as Background for Estuarine Management and Development. J.H. Sharp, ed. University of Delaware Marine Lab and New Jersey Marine Sciences Consortium, Lewes, Del.

**2. Principal Investigator:**

**Name:** Jonathan H. Sharp  
**Address:** University of Delaware

**Telephone:** (302)645-4259

**As of (date):**  
12/90

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthos-commercial production of adult oysters and blue crabs

**5. Sample Matrices:**

Sediments-benthic communities

**6. Sampling Design:**

**Purpose of Study:** Discuss oyster and crab industries and their roles in overall benthos of Delaware Bay.

**Sample Dates:** **Beginning:** **End:**

**Sample Frequency:** In literature

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware Bay	16 - 80	Specific coordination not given in publication but shown in Figure 1.

7. **Sampling Methodologies:**  
Sample Gear, Methods and Analyses: N/A (used literature)  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
8. **Data Processing:**  
Used historical yearly data.
9. **Data Evaluation:**
10. **Companion Studies:**  
Maurer et al. 1978a  
Kinner and Leathem 1974  
Haskin et al. 1978
11. **Comments:**  
Complete general description of the history of the oyster and crab industries in Delaware Bay.

1. **Cited Reference:**  
Haskin, H., L.A, Stauber and J.H. Mackin. 1966. *Michinia nelsoni* n. sp. (*Haplosporida*, *Haplosporidiidae*) Causative agent of the Delaware Bay Oyster epizootic. Science 153:1414-1416.
2. **Principal Investigator:**  
Name: Harold H. Haskin  
Address: Rutgers' Shellfish Lab  
Port Norris, New Jersey  
Telephone: (609)785-0074 As of (date): 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Benthic community-oyster disease
5. **Sample Matrices:**  
Sediment-benthic community
6. **Sampling Design:**  
Purpose of Study: Describe MSX and its effect on the oyster community Delaware Bay  
Sample Dates: Beginning: N/A End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
N/A	N/A	N/A

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses: N/A**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Gives short description of the MSX epidemic of 1975 in Delaware Bay.

1. **Cited Reference:**  
Howe, S., D. Maurer and W. Leathem. 1988. Secondary production of benthic molluscs from the Delaware Bay and coastal area. Est. Coast. Shelf. Sci. 26:81-94.
  
2. **Principal Investigator:**  
**Name:** Stavros Howe  
**Address:** Molecular Ecology Institute  
 Biology Dept.  
 CA State University Long Beach  
 Long Beach, CA 90840  
**Telephone:** (213)498-5343 **As of (date):** 1988
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic taxonomic diversity and abundance
  
5. **Sample Matrices:**  
Sediments-benthic community
  
6. **Sampling Design:**  
**Purpose of Study:** Estimate annual variation in production and turnover for select species and total communities and compare to known data  
**Sample Dates:** **Beginning:** March 1980 **End:** Nov 1981  
**Sample Frequency:** 12 times in 2 years  
**Number of Sampling Stations:** 1 in Delaware Bay

**Sample Locations:**

General Location	DRBC River km	Coordinates
One inside the mouth of Delaware Bay. 7 on Delaware coast	0	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Smith McIntyre Grab

**Number of Replicate Samples:** 3

**Area of Volume per Replicates:** .1 m<sup>2</sup>

**Net, sieve, or filter size:** .5 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Monthly means for month sampled, total annual production, mean annual biomass.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
 Ichthyological Associates, Inc. 1974. An ecological study of the Delaware River in the vicinity of Edge Moor Power Station. Progress report for Oct-Dec 1973. Ichthyological Associates, Inc. Wilmington, DE. (Delmarva Power and Light Co.) 109 p.
  
2. **Principal Investigator:**  
**Name:** Edward C. Raney, Ph.D., Director  
**Address:** Ichthyological Associates, Inc.  
 301 Forest Drive  
 Ithaca, New York 14850  
**Telephone:** (607)533-8801 **As of (date):** Feb 1974
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance
  
5. **Sample Matrices:**  
 Sediment-benthic community
  
6. **Sampling Design:**  
**Purpose of Study:** Estimate population abundance  
**Sample Dates:** Beginning: 12 Oct 1973 End: 15 Nov 1973  
**Sample Frequency:** 2 collections  
**Number of Sampling Stations:** 9

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Edge Moor Power Station	70 - 80	Specific coordinations not given in publication but shown in Table 14.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Ponar grab

**Number of Replicate Samples:** Existence of replicate samples  
not mentioned

**Area of Volume per Replicates:** .05 m<sup>2</sup>

**Net, sieve, or filter size:** .5 mm mesh sieve

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Population densities given by sample data and location.

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates 1974b

**11. Comments:**

1. **Cited Reference:**  
 Jeffries, L.R., R.A. Lutz, and H.H. Haskin. 1981. The Delaware Bay oyster industry: an overview. 9 p. In: Proceedings of the North American Oyster Workshop. Special Publication No. 1. Louisiana State University Division of Continuing Education. Baton Rouge, Louisiana. 300 p.
  
2. **Principal Investigator:**  
**Name:** Luther R. Jeffries  
**Address:** Cumberland Research Corp.  
 Box 343  
 Port Norris, New Jersey 08349  
**Telephone:** \_\_\_\_\_ **As of (date):** 1982
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic shellfish abundance
  
5. **Sample Matrices:**  
 Sediment-benthic abundance
  
6. **Sampling Design:**  
**Purpose of Study:** Summary of the oyster industry of Delaware Bay including significant events and dates and description of seed beds, leased grounds, and regulatory controls.  
**Sample Dates:** Beginning: N/A End: N/A  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bay -- oyster beds approximately from Cedar Creek to Mad Horse Creek	16 - 80	Specific coordinates not given in publication

**7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses: N/A**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Kinner, P., and D. Maurer. 1978. Polychaetous annelids of the Delaware Bay area. Fish. Bull. 76:209-224.
2. **Principal Investigator:**  
Name: Peter Kinner  
Address: Field Station, College of Marine Studies  
University of Delaware  
Lewes, Delaware  
Telephone: (302)645-4000 As of (date): 1974
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Benthic polychaete abundance and composition
5. **Sample Matrices:**  
Sediment-benthic community
6. **Sampling Design:**  
Purpose of Study: Review the composition distribution and general ecology of polychaetous annelids in the Delaware Bay.  
Sample Dates: Beginning: 1967 End: 1977  
Sample Frequency: 1303 quantitative, 887 qualitative  
Number of Sampling Stations: 10 areas

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bay proper. From the mouth to the head of Delaware Bay	0 to 77	Specific coordinates not given in publication but shown in Figure 1.

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Varied - many studies  
  
**Number of Replicate Samples:**  
**Area of Volume per Replicates:**  
**Net, sieve, or filter size:**  
**Other methodologies:**  
**Quality control measures:**
8. **Data Processing:**
9. **Data Evaluation:**
10. **Companion Studies:**  
See bibliography in Kinner and Maurer 1978 for complete listing.
11. **Comments:**

1. **Cited Reference:**  
Kinner, P., D. Maurer, and W. Leathem. 1974. Benthic invertebrates in Delaware Bay: Animal-sediment associations of the dominant species. *Int. Revue ges Hydrobiol.* 59:685-701.
  
2. **Principal Investigator:**  
**Name:** Peter Kinner  
**Address:** Field Station, College of Marine Studies  
University of Delaware  
Lewes, DE  
**Telephone:** (302)645-4000 **As of (date):** 1974
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic taxonomic composition and abundance
  
5. **Sample Matrices:**  
Sediment-benthic community
  
6. **Sampling Design:**  
**Purpose of Study:** Determine the composition of benthic fauna near the mouth of Delaware Bay.  
**Sample Dates:** **Beginning:** Dec 1971 **End:** June 1972  
**Sample Frequency:**  
**Number of Sampling Stations:** 105

**Sample Locations:**

General Location	DRBC River km	Coordinates
Near the mouth of Delaware Bay	0 to 5	38° 47'N latitude 75° 07'W longitude

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Peterson grab

**Number of Replicate Samples:** Not given in publication

**Area of Volume per Replicates:** .1 m<sup>2</sup>

**Net, sieve, or filter size:** 1.0 mm sieve

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Gives rank, number/m<sup>2</sup> and cumulative percent of benthic invertebrates.

**9. Data Evaluation:**

**10. Companion Studies:**

Maurer et al. 1974

**11. Comments:**

1. **Cited Reference:**  
Leathem, W., and D. Maurer. 1980. Decapod crustaceans of the Delaware Bay area. *Journal of Natural History*. 14:813-828.
2. **Principal Investigator:**  
**Name:** Wayne Leathem  
**Address:** College of Marine Studies  
University of Delaware  
Lewes, DE 19958  
**Telephone:** (302)645-4000 **As of (date):** 1980
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
**Parameters measured:** Benthic decapod abundance and distribution
5. **Sample Matrices:**  
Sediment-benthic community
6. **Sampling Design:**  
**Purpose of Study:** Describe distribution and general ecology of decapod crustaceans in the Delaware Bay area.  
**Sample Dates:** **Beginning:** 1968 **End:** 1976  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to Cross Ledge Range	0 - 50	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**  
Summary of species distributions given by various publications  
over 8 years.

**9. Data Evaluation:**

**10. Companion Studies:**  
Watling & Maurer (eds.) 1976  
Maurer et al. 1974  
Maurer and Watling 1973

**11. Comments:**

1. **Cited Reference:**  
Maurer, D. 1974a. Biological condition of the deep-water portion of lower Delaware Bay. Lewes Field Station, Lewes, Delaware. Grant No. GI 33369, NSF-RANN. 94 p.
2. **Principal Investigator:**  
Name: Don Maurer  
Address: CA State University Long Beach  
SO CA Ocean Study Consortium  
Long Beach, CA 90840  
Telephone: (213)985-7874 As of (date): 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Benthic abundance distribution
5. **Sample Matrices:**  
Sediment-benthic community
6. **Sampling Design:**  
Purpose of Study: Discuss benthic assemblages, speciation, and distribution  
Sample Dates: Beginning: End:  
Sample Frequency: Used literature  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware Bay to the Chesapeake and Delaware Canal	9 - 96	Specific coordinates not given in publication

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Used literature  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Watling and Maurer 1972a,b, 1973  
Maurer et al. 1974  
Watling et al. 1974a
- 11. Comments:**

**1. Cited Reference:**

Maurer, D. 1974b. Impacts of a deepwater terminal: Volume I, Environmental problems associated with a deepwater port in the Delaware Bay area. Philadelphia Academy of Natural Sciences, the University of Delaware, and Rutgers University. Grant No. GI 33369, NSF-RANN. 206 pp.

**2. Principal Investigator:**

**Name:** Don Maurer  
**Address:** CA State University Long Beach  
SO CA Ocean Study Consortium  
Long Beach, CA 90840  
**Telephone:** (213)985-7874 **As of (date):** 1990

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic abundance and distribution

**5. Sample Matrices:**

Sediment-benthic community

**6. Sampling Design:**

**Purpose of Study:** Discuss benthic assemblages, speciation, and distribution.

**Sample Dates:** **Beginning:** **End:**

**Sample Frequency:** Used literature

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
The mouth of Delaware Bay to the Chesapeake and Delaware Canal	0 - 96	Specific coordinates not given in publication

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Used literature  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Watling and Maurer 1972a,b, 1973  
Maurer et al. 1974  
Watling et al. 1974a
- 11. Comments:**

**1. Cited Reference:**

Maurer, D., and L. Watling. 1973a. The biology of the oyster community and its associated fauna in Delaware Bay. Delaware Bay Report Series. Volume 6, College of Marine Studies, University of Delaware, Newark, DE. 97 p.

**2. Principal Investigator:**

**Name:** Dennis F. Polis, Report Series Editor  
**Address:** National Geographic Society

**Telephone:**

**As of (date):** 1973

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic species diversity and abundance

**5. Sample Matrices:**

Sediment-benthic community

**6. Sampling Design:**

**Purpose of Study:** Describe the composition of fauna of Delaware's oyster beds.

**Sample Dates:** **Beginning:** 1967 **End:** 1971

**Sample Frequency:** ~ 800 samples

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
From Cedar Creek to Mad Horse Creek	16 - 80	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Oyster dredge sampling

**Number of Replicate Samples:** Not given

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** Not given

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

Species list, (occurrence and distribution), composition of fauna by group.

**10. Companion Studies:**

Maurer and Watling 1973b

**11. Comments:**

**1. Cited Reference:**

Maurer, D., and L. Watling. 1973b. Studies on the oyster community in Delaware: the effects of the estuarine environment on the associated fauna. Int. Revue Geo. Hydrobiol. 58:161-201.

**2. Principal Investigator:**

<b>Name:</b>	Don Maurer	Les Watling
<b>Address:</b>	CA State University SO CA Ocean Study Consortium Long Beach, CA 90840	Dept. Oceanography Ira C. Carling Marine Center University of Maine at Orono Walpole, Maine (207)563-3146
<b>Telephone:</b>	(213)985-7874	As of (date): 1990

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic abundance and special distribution for oysters

**5. Sample Matrices:**

Sediment-benthos

**6. Sampling Design:**

**Purpose of Study:** Determine composition of the associated fauna of Delaware's oyster beds

**Sample Dates:** Beginning: 1967 End: 1971

**Sample Frequency:**

**Number of Sampling Stations:** Number of oyster beds

**Sample Locations:**

General Location	DRBC River km	Coordinates
Oyster beds from Murderkill to Liepsic River	37-54	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

<b>Sample Gear, Methods and Analyses:</b>	10/68, 6/69	10/69, 6/69, 5/70
	basket dredge .9 m mouth	oyster dredge 1.3 m mouth

<b>Number of Replicate Samples:</b>	1	whole
sample		

<b>Area of Volume per Replicates:</b>	1 gallon mesh	.25 mm
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**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Presented by bed (station) from which it was collected (cumulative).

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

**1. Cited Reference:**

Maurer, D., L. Watling and G. April. 1974. The distribution and ecology of common marine and estuarine pelecypods in the Delaware Bay area. The Nautilus. 88:38-45.

**2. Principal Investigator:**

**Name:** Don Maurer  
**Address:** CA State University Long Beach  
Southern CA Ocean Study Consortium  
Long Beach, CA 90840  
**Telephone:** (213)985-7874

**As of (date):**  
12/90

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic bivalve abundance and distribution

**5. Sample Matrices:**

Sediment-benthic community

**6. Sampling Design:**

**Purpose of Study:** Determine the ecology and distribution of common marine and estuarine pelecypods in Delaware Bay area.

**Sample Dates:** Beginning: 1967 End: 1973

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Off Cape Henlopen and transect from Woodland Beach	0 - 67	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Hard clam dredge, hydraulic surf clam dredge, Van Veen Bottom Grab .1 m<sup>2</sup>, oyster dredge, Peterson bottom grabs (.1 m<sup>2</sup> and 1/15 m<sup>2</sup>), epibenthic dredge.

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:** Determined by sample gear

**Net, sieve, or filter size:** Not mentioned in study

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Much of the data is outside of Delaware Bay.

1. **Cited Reference:**  
Maurer, D., L. Watling, and R. Keck. 1971. The Delaware oyster industry: A reality? *Trans. Am. Fish. Soc.* 100:100-111.
2. **Principal Investigator:**  
**Name:** Don Maurer  
**Address:** CA State University Long Beach  
Southern CA Ocean Study Consortium  
Long Beach, CA 90840  
**Telephone:** (213)985-7874 **As of (date):** 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
**Parameters measured:** Benthos-oysters standing crop, height & width (size classes)
5. **Sample Matrices:**  
Sediments-benthic communities
6. **Sampling Design:**  
**Purpose of Study:** Determine general condition of Delaware oyster beds after mass mortalities from MSX in 1950's and 1960's.  
**Sample Dates:** **Beginning:** 1968 **End:** 1970  
**Sample Frequency:** Irregularly, variable  
**Number of Sampling Stations:** 13

**Sample Locations:**

General Location	DRBC River km	Coordinates
Planted and natural oyster beds from below Bombay Hook on the western shore south to beds off the St. Jones River. In 5 tributaries: Leepsic, St. Johns, Murderkill, Mispillion and Broadkill. See Fig. 1 p. 101.	~ 20 - 40	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Commercial dredges

**Number of Replicate Samples:** Existence of replicate samples  
not mentioned

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** None given

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Data presented by date sampled (for each station) and year

**9. Data Evaluation:**

**10. Companion Studies:**

Miller 1962

Haskin, Canzonier and Myare 1965

**11. Comments:**

**1. Cited Reference:**

Maurer, D., L. Watling, P. Kinner, W. Leathem, and C. Wethe. 1978. Benthic Invertebrate Assemblages of Delaware Bay. Marine Biology. 45:65-78.

**2. Principal Investigator:**

**Name:** Don Maurer  
**Address:** CA State University, Long Beach  
Southern CA Ocean Study Consortium  
Long Beach, CA 90840

**Telephone:** (213)985-7874

**As of (date):**  
12/90

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic abundance and composition

**5. Sample Matrices:**

Sediment-benthos

**6. Sampling Design:**

**Purpose of Study:** Determine the composition and distribution of benthic invertebrate assemblages in Delaware Bay and investigate their relationship to environmental factors.

**Sample Dates:** Beginning: July 1972 End: July 1973

**Sample Frequency:** During summers of these two years

**Number of Sampling Stations:** 105

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of the bay to Stow Creek	0 - 67	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Peterson grab

**Number of Replicate Samples:** Existence of replicate samples  
not mentioned

**Area of Volume per Replicates:** 0.1 m<sup>2</sup>

**Net, sieve, or filter size:** 1.0 mm mesh sieve

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Publication gives yearly average abundance of benthos.

**9. Data Evaluation:**

**10. Companion Studies:**

Maurer and Watting 1973

Watting et al. 1974

Kinner et al. 1974

Kinner and Maurer 1978

**11. Comments:**

1. **Cited Reference:**  
Miller, M.E. 1962. The Delaware oyster industry, past and present. Ph.D. diss. Boston University Graduate School. 329 p.
2. **Principal Investigator:**  
Name: Mary Emily Miller  
Address: Boston University  
  
Telephone: \_\_\_\_\_ As of (date): 1962
3. **Repository of data set or reference:**  
University of Delaware, Morris Library
4. **General Data Type:**  
Parameters measured: Benthic-oyster landings and distribution
5. **Sample Matrices:**  
Sediment-benthic community
6. **Sampling Design:**  
Purpose of Study: Provide a comprehensive history of the Delaware oyster industry.  
Sample Dates: Beginning: N/A End: N/A  
Sample Frequency:  
Number of Sampling Stations: N/A

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bay oyster beds Cedar Creek to Mad Horse Creek	16 - 86	No specific coordinates given to study

**7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses: N/A**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**  
**N/A**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

**1. Cited Reference:**

Orris, P.K. 1974. A qualitative and quantitative study of benthic macroinvertebrates in the Delaware River in the vicinity of Edge Moor Power Station. 27 p. In: An Ecological Study of the Delaware River in the Vicinity of Edgemoor Power Station. Progress report for the period Jan-May 1974. Ichthyological Associates, Inc., Wilmington, DE. (Delmarva Power and Light Co.)

**2. Principal Investigator:**

**Name:** Timothy L. Preddice, Project Leader

**Address:** IA, Inc.  
c/o Edge Moor Power Station  
800 King St.  
Wilmington, DE 19899

**Telephone:** (302)378-9881 **As of (date):** 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic abundance and biomass

**5. Sample Matrices:**

Sediment-benthic community

**6. Sampling Design:**

**Purpose of Study:** Determine identify and distribution of benthic macroinvertebrates in the vicinity of Edge Moor Power Station.

**Sample Dates:** **Beginning:** Jan 1974 **End:** May 1974

**Sample Frequency:** Monthly & bimonthly

**Number of Sampling Stations:** 9

**Sample Locations:**

General Location	DRBC River km	Coordinates
Vicinity of Edge Moor Power Station	117 - 120	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Ponar grab

**Number of Replicate Samples:** 2

**Area of Volume per Replicates:** .05 m<sup>2</sup>

**Net, sieve, or filter size:** .5 mm sieve

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Mean population density and biomass presented monthly.

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Assoc. 1974a,b

**11. Comments:**

**1. Cited Reference:**

Price, K.S., Jr. 1962. Biology of the sand shrimp *Crangon septemspinosa*, in the shore zone of the Delaware Bay region. Ches. Sci. 3:244-255.

**2. Principal Investigator:**

**Name:** Kent S. Price, Jr.  
**Address:** University of Delaware  
College of Marine Studies  
Lewes, Delaware  
**Telephone:** (302)645-4000 **As of (date):** 1962

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic abundance - shrimp

**5. Sample Matrices:**

Sediment-benthic community

**6. Sampling Design:**

**Purpose of Study:** Shows population dynamics of *Crangon septemspinosa* as well as biology.

**Sample Dates:** **Beginning:** Jan 1960 **End:** Oct 1960

**Sample Frequency:** 41 collections

**Number of Sampling Stations:** 9 in Delaware Bay (3 on coast)

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of the Delaware Bay to Cohansey River	0 - 61	Specific coordinates not given in publication but shown in Figure 1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Hand seine, push net

**Number of Replicate Samples:** 3

**Area of Volume per Replicates:** Not mentioned in study

**Net, sieve, or filter size:** 1/4 in mesh

**Other methodologies:** 3 hauls at each station

**Quality control measures:**

**8. Data Processing:**

Data presented monthly. Shows population dynamics of *Crangon septemspinosa*. No collections below 4 ppt salinity.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Public Service Electric and Gas Company. 1980. An Ecological Study of the Delaware River near Artificial Island, 1968-1967: A summary. PSE&G, Newark, New Jersey.
  
2. **Principal Investigator:**  
**Name:** Ichthyological Associates, Inc.  
**Address:** Dr. Edward C. Ramey  
Middletown, DE 19709  
**Telephone:** (302)378-9881 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance and distribution.
  
5. **Sample Matrices:**  
Sediment-benthic community
  
6. **Sampling Design:**  
**Purpose of Study:** Describe local distribution and abundance of benthic communities.  
**Sample Dates:** **Beginning:** 1973 **End:** 1976 = standardized quantitative  
  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:** 28

**Sample Locations:**

General Location	DRBC River km	Coordinates
Just south of Smyrna River to the Chesapeake and Delaware Canal	70 - 96	Specific coordinates not given in publication but shown in Figure 33.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Ponar grab

**Number of Replicate Samples:** Not given in publication

**Area of Volume per Replicates:** Not given in publication

**Net, sieve, or filter size:** #35 U.S. sieve - .5 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Monthly densities presented.

**9. Data Evaluation:**

**10. Companion Studies:**

Connelly 1974

Smith 1974

**11. Comments:**

1. **Cited Reference:**  
Public Service Electric and Gas Company. 1984a. Salem Generating Station 316(b) Demonstration, Section 2. NPDES permit No. NJ0005622. Prepared by PSE&G, Newark, New Jersey.
  
2. **Principal Investigator:**  
Name: PSE&G  
Address: 80 Park Plaza  
Newark, NJ  
Telephone: (201)621-7500                      As of (date):
  
3. **Repository of data set or reference:**
  
4. **General Data Type:**  
Parameters measured: Benthic macroinvertebrates taxa densities. Benthic community abundance and composition.
  
5. **Sample Matrices:**  
Sediment-benthic community
  
6. **Sampling Design:**  
Purpose of Study: Discuss the principal factors regulating community composition, distribution and abundance.  
Sample Dates: Beginning: 1973                      End: 1976  
Sample Frequency: Monthly  
Number of Sampling Stations: 28

**Sample Locations:**

General Location	DRBC River km	Coordinates
25 km south of Artificial Island to 25 km north of Artificial Island	58 - 108	Specific coordinates not given in publication

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Ponar grab

**Number of Replicate Samples:** None stated in publication

**Area of Volume per Replicates:** Not given in publication

**Net, sieve, or filter size:** #35 U.S. sieve - .5 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Monthly densities in Artificial Island studies

**9. Data Evaluation:**

**10. Companion Studies:**

PSE&G 1980

Smith 1974

Connelly 1974

**11. Comments:**

1. **Cited Reference:**  
Public Service Electric and Gas Co. 1984b. *Gammarus tigrinus* group: A synthesis of information on natural history, with reference to occurrence in the Delaware River and Estuary and involvement with Salem Generating Station 316(b) Demonstration, Appendix IV.
  
2. **Principal Investigator:**  
Name: PSE&G  
Address: 80 Park Plaza  
Newark, NJ 07101  
Telephone: (201)621-7500 As of (date):
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Benthic distribution and abundance - amphipods
  
5. **Sample Matrices:**  
Sediment-benthic communities
  
6. **Sampling Design:**  
Purpose of Study: Present all field and onsite data collected for the *Gammarus tigrinus* group, and technical information on the species and its use of the Delaware estuary.  
Sample Dates: Beginning: 1977 End: 1980  
Sample Frequency: Not given in this report  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
General distribution in Delaware Bay and around Salem	64 - 97	Not given in this report

7. **Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Not given in this report  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
8. **Data Processing:**  
Mean of all data collected from 1977-1980.
9. **Data Evaluation:**
10. **Companion Studies:**  
PSE&G Co. 1984a,b
11. **Comments:**  
Provide good information for justification of this group and numbers for figures. Good description of ecological role.

1. **Cited Reference:**  
Rutgers Shellfish Laboratory. Unpublished data.
2. **Principal Investigator:**  
**Name:** Rutgers University  
**Address:** P.O. Box 687  
Norris, New Jersey 08349  
**Telephone:** (609)785-0074 **As of (date):**
3. **Repository of data set or reference:**  
Rutgers Shellfish Laboratory
4. **General Data Type:**  
**Parameters measured:** Shellfish
5. **Sample Matrices:**  
Sediment-benthic communities
6. **Sampling Design:**  
**Purpose of Study:** Collect information on shellfish in the Delaware estuary.  
**Sample Dates:** **Beginning:** 1950 **End:** Present  
**Sample Frequency:** Variable  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217	

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:** Variable

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:** Accumulate data on plankton, oyster seed beds, miscellaneous information, condition oyster index, nutrients, productivity, and river flow, etc., in the Delaware estuary.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:** The contents of these datasets provide historical and current information on shellfish in the Delaware Estuary. Most of the data exists in files and has not been computerized. It was beyond the scope of this project to attempt to analyze this information.

1. **Cited Reference:**  
Shuster, C.N., Jr., and M.L. Botton. 1985. A contribution to the population biology of horseshoe crabs, *Limulus polyphemus*, in Delaware Bay. *Estuaries* 8:363-372.
2. **Principal Investigator:**  
Name: Carl N. Schuster, Jr.  
Address: General Research Corp.  
Environmental Sciences Operations  
McLean, VA 22102  
Telephone: \_\_\_\_\_ As of (date): 1985
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Benthic abundance - horseshoe crabs
5. **Sample Matrices:**  
Sediment-benthic community
6. **Sampling Design:**  
Purpose of Study: Contrast results of this biological survey with historical estimates of abundance of horseshoe crabs.  
Sample Dates: Beginning: 1977 End: 1980  
Sample Frequency: Variable  
Number of Sampling Stations: 18

**Sample Locations:**

General Location	DRBC River km	Coordinates
Areas along shoreline from Augustine Beach south to beaches at the mouth of Delaware Bay	~ 0 - 80	Specific coordinates not given in publication but shown in Figure 1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Spawning surveys - counts of eggs clusters spawning males and gravid females on beaches.

**Number of Replicate Samples:** N/A

**Area of Volume per Replicates:** N/A

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Yearly summaries - commercial harvest (every 10 years) and survey years.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Includes numbers for horseshoe crabs harvest every 10 years from 1871 to 1981.

1. **Cited Reference:**  
Smith, R.W. 1974. A quantitative study of benthic macroinvertebrates of the Delaware River in the vicinity of Artificial Island. 31 p. In: An Ecological Study of the Delaware River in the vicinity of Artificial Island. Ichthyological Associates, Middletown, DE. 710 p.
  
2. **Principal Investigator:**  
**Name:** Victor J. Schuler  
**Address:** Ichthyological Associates, Inc.  
100 S. Cass St.  
Middletown, DE 19709  
**Telephone:** (302)378-9881                      **As of (date):** 1974
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance, biomass, and diversity.
  
5. **Sample Matrices:**  
Sediment-benthic community
  
6. **Sampling Design:**  
**Purpose of Study:** Discuss preliminary studies of benthic macroinvertebrates in the vicinity of Artificial Island.  
**Sample Dates:** **Beginning:** June 1971    **End:** Day 1971  
**Sample Frequency:** Regularly, during daylight  
**Number of Sampling Stations:** 20

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Artificial Island	70 - 96	Specific coordinates not given in publication but shown in Figure. 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Ponar grab

**Number of Replicate Samples:** Existence of replicate samples  
not mentioned

**Area of Volume per Replicates:** .05 m<sup>2</sup>

**Net, sieve, or filter size:** #35 .5 mm (.0197 in.) mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Benthic data presented in report by station and date.

**9. Data Evaluation:**

**10. Companion Studies:**

Connelly 1974

Ichthyological Assoc. 1980

**11. Comments:**

**1. Cited Reference:**

U.S. Fish and Wildlife Service. 1979. The effect of salinity change on the American oyster in Delaware Bay.

**2. Principal Investigator:**

**Name:** USFWS  
**Address:** State College, PA

**Telephone:** \_\_\_\_\_ **As of (date):** 1979

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Benthic abundance - oysters

**5. Sample Matrices:**

Sediment-benthic community

**6. Sampling Design:**

**Purpose of Study:** Evaluate the effect of salinity change on the American oyster

**Sample Dates:** **Beginning:** \_\_\_\_\_ **End:** \_\_\_\_\_

**Sample Frequency:** Based on published and unpublished literature and personal interviews

**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Egg Island to Round Island	~ 33 - 72	Specific coordinates not given in publication but shown in Figure 1.

**7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Based on literature

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**  
Yearly summaries by pounds harvested and beds

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Walton, T.E. III, and R. Patrick (eds.) 1973. The Delaware Estuary System Environmental Impacts and Socioeconomic Effects: The Delaware River Estuarine Marsh Survey. National Science Foundation. Rep. No. GI-33369. NSF/RA/E-73-013. 174 p.
2. **Principal Investigator:**  
Name: Thomas E. Watton, III  
Address: University of Delaware  
Newark, DE  
Telephone: (302)645-4000 As of (date): 1973
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Benthic species composition
5. **Sample Matrices:**  
Sediment-benthic community
6. **Sampling Design:**  
Purpose of Study: Describe the important marshlands in the Delaware estuary in terms of its aquatic communities and impacts resulting from human activities.  
Sample Dates: Beginning: 1970 End: 1972  
Sample Frequency: Summer and fall 1972  
Number of Sampling Stations: 154

**Sample Locations:**

General Location	DRBC River km	Coordinates
Marshlands along the entire Delaware estuary and in the river up to Trenton	0 - 240	Specific coordinates not given in publication

7. **Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Not given  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
8. **Data Processing:**  
Summary of findings for dominant and common species.
9. **Data Evaluation:**
10. **Companion Studies:**
11. **Comments:**

1. **Cited Reference:**  
 Watling, L., and D. Maurer. 1972. Shallow water amphipods of the Delaware Bay region. *Crustaceana Suppl.* 3:251-266.
  
2. **Principal Investigator:**  
**Name:** Les Watling  
**Address:** Dept. Oceanography  
 Ira C. Darling Marine Center  
 University of Maine at Orono  
 Walpole, Maine  
**Telephone:** (207)563-3146 **As of (date):** 1990
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Benthic abundance and distribution - amphipods
  
5. **Sample Matrices:**  
 Sediment-benthic communities
  
6. **Sampling Design:**  
**Purpose of Study:** To determine composition and distribution of local amphipod fauna with reference to salinity and substrate - no quantitative measurements taken.  
**Sample Dates:** Beginning: Summer 1968 End: Winter 1970  
**Sample Frequency:**  
**Number of Sampling Stations:** 22 (in bay) (5 outside)

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape Henlopen to Duck Creek	0 - 65	Specific coordinates not given in publication but shown in Figure 1

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Oyster dredge (1.3 m mouth), box dredge (75 cm mouth)

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** .25 mm mesh sieve

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Relative abundance by station presented.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

**1. Cited Reference:**

Watling, L., D. Maurer, and C. Wethe. 1976. Delaware Bay benthic invertebrate assemblages. 64 p. In: Ecological Studies on Benthic and Planktonic Assemblages in Lower Delaware Bay. (L. Watling and D. Maurer, eds.) NSF/RANN.

**2. Principal Investigator:**

<b>Name:</b>	Don Maurer	Les Watling
<b>Address:</b>	CA State University Long Beach SO CA Ocean Study Consortium Long Beach, CA 90840	Dept. Oceanography Ira C. Darling Marine Center University of Maine at Orono Walpole, Maine (207)563-3146
<b>Telephone:</b>	(213)985-7874	As of (date): 1976

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland (entire copy at University of Delaware - Morris Library)

**4. General Data Type:**

**Parameters measured:** Benthic composition and abundance

**5. Sample Matrices:**

Sediment-benthic communities

**6. Sampling Design:**

**Purpose of Study:** Determine composition and distribution of benthic invertebrate assemblages in Delaware Bay.

**Sample Dates:** Beginning: July-Aug 1972 End: June-July 1973

**Sample Frequency:** 207 samples over 2 years

**Number of Sampling Stations:** 3

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape Henlopen - Cape May area to Stow Creek	0 - 67	Specific coordinates not given in publication but shown in Figure V-1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** .1 m<sup>2</sup> Peterson grab

**Number of Replicate Samples:** 1

**Area of Volume per Replicates:** .1 m<sup>2</sup>

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Abundance presented by year

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

**FISH**

**1. Cited Reference:**

Abbe, G.R. 1967. An evaluation of the distribution of fish populations of the Delaware River estuary. M.S. Thesis, Univ. Delaware. 64 p.

**2. Principal Investigator:**

**Name:** George R. Abbe

**Address:** University of Delaware  
Newark, DE

**Telephone:** As of (date): 1967

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Fish - relative abundance, distribution, mean total length

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Study the distribution of Delaware Bay species with regard to temperature, salinity, depth and other factors

**Sample Dates:** Beginning: Aug 1966 End: Jan 3, 1967

**Sample Frequency:** Twice weekly-summer, 1 trip/week-fall

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bay	0 - 72	Specific coordinates not given in study

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Bay divided into sectors (5' lat. x 5' long.) + 3 zones (west, central, east) sample 1 zone/day.

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 3" stretch body, 2" stretch cod end

**Other methodologies:**

**Quality control measures:** Trawl 1/2 hour

**8. Data Processing:**

Attempted to determine a relationship between physical and biological parameters. Tabulated these relationships and these corresponding correlation coefficients. Tabulated total number of fish of each species collected and determined a relative abundance for each species. Reported mean number of fish (by species) caught/trawl and their mean length. Also reported results of correlations of individual species with physical factors.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study provides historical information on species relative abundance (total number caught x frequency of occurrence) and average number caught per trawl. It also provides some seasonal distribution data. Weakfish + hogchoker > 50% of catch.

1. **Cited Reference:**  
Academy of Natural Sciences of Philadelphia. 1974. Ecological studies in New Jersey: Oldmans Creek, Raccoon Creek, Birch Creek, and the Delaware River. Interim Report for Shell Oil Co. Philadelphia, PA 406 p.
2. **Principal Investigator:**  
**Name:** Academy of Natural Sciences of Philadelphia  
**Address:** Philadelphia, PA 19103  
  
**Telephone:** (215)299-1109 **As of (date):**
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
**Parameters measured:** Fish distribution, relative abundance, frequency of occurrence
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
**Purpose of Study:** Establish baseline data, project future conditions in vicinity of propose refinery  
**Sample Dates:** **Beginning:** 1972 **End:** 1973  
**Sample Frequency:** Variable, depending on gear, location  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Oldmans Creek NJ	124	Specific coordinates not given in study
Birch Creek		
Delaware River Del. Mem. Bridge	111	
Penns Grove	117	
Oldmans Creek	124	
S. of Raccoon Creek	127	
Tinicum Island	140	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 6' balloon trawl (5 min tows), 15' balloon trawl (used at Delaware River stations, electroshocker, and gill nets) - 20' bag seine (3 15-20yd hauls parallel to shore, stretched mesh = 1/2").

**Number of Replicate Samples:** Existence of replicate samples not mentioned

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate dominant and subdominant species in the New Jersey study area. Summarize information on the biology and seasonal migrations of many species in the upper Delaware estuary. Estimated relative abundance of species collected with seine and presented in tables.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Much of the data collected is presented in a relatively raw format, species summaries provide information on distribution patterns at each of the sample stations. Relative abundance of species collected in the Delaware River may be comparable to other surveys.

Ranges for relative abundance index

1-9 = 1

10-99 = 2

100-999 = 3

1. **Cited Reference:**  
Albert, R.C. 1988. The historical context of water quality management for the Delaware Estuary. Estuaries 11:99-107.
2. **Principal Investigator:**  
**Name:** Richard C. Albert  
**Address:** Delaware River Basin Commission  
West Trenton, NJ  
**Telephone:** (609)883-9500 **As of (date):** 12/90
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
**Parameters measured:** Water quality-changes in water pollution
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
**Purpose of Study:** Examine evolutionary process of water pollution control in the Delaware Estuary  
**Sample Dates:** **Beginning:** 1800 **End:** Present  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary Trenton to Mouth of Bay	0 - 217 +	Specific coordinates not given in paper.

7. **Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Examine available literature
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
8. **Data Processing:**
  - Describe 5 generations of water pollution control efforts.
9. **Data Evaluation:**
10. **Companion Studies:**
11. **Comments:**
  - Although data not directly related to fisheries of the Delaware estuary, some of the critical pollution periods may have directly influenced fish populations and distribution especially for anadromous species. This papers documents when the worst conditions occurred.

**1. Cited Reference:**

Anselmini, L.D. 1974. An ecological study of the Delaware River in the vicinity of the Mercer Generating Station, Part 1, Fish. Ichthyological Associates, Inc., Ithaca, NY. 615 p.

**2. Principal Investigator:**

Name: Ludwig D. Anselmini  
Address: Ichthyological Associates, Inc.  
Ithaca, NY  
Telephone: (607)533-8801 As of (date): 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

Parameters measured: Fish - abundance, distribution

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

Purpose of Study: Distribution and abundance of fish species near Mercer generating station

Sample Dates: Beginning: June 1970 End: Dec 1972

Sample Frequency: Weekly 1970-1971  
Biweekly - 1972

Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mercer Generating Station	209	Specific coordinates not given in study.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Fished trawl on bottom, 5 minute tow with tide. In autumn, used 25' trawl at surface for 10 minutes. Semi-balloon otter trawl. Seine 10' (1/8" ace mesh) and 24' gag seine (1/4" mesh) x 5' deep.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

16' otter trawl. 5 sweeps with a seine net were considered one collection. Also examined impingement of fish on intake screens weekly in 1972 and 1973.

**Quality control measures:**

**8. Data Processing:**

Provide checklist of species collected. Summary of relative abundance fishes in collections using each gear are discussed.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provide information on relative abundance of species in the freshwater region of the Delaware estuary. Raw data provided on number of species caught per gear effort. May be able to determine average catch per unit effort values (CPUE) for some species from raw data.

Describes sportfishing near Mercer in spring and early summer mainly for anadromous fishes. Alewife and blueback herring caught in large numbers. American shad and small striped bass taken occasionally.

1. **Cited Reference:**  
Atlantic City Electric Company. 1977. Deepwater Station 316 (b) Oct. 1975 - April 1977. Impingement and entrainment report. Deepwater Generating Station.
  
2. **Principal Investigator:**  
Name: Atlantic City Generating Station  
Address:  
  
Telephone: As of (date): 1977
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Fish - # fish impinged/hour, % species composition, seasonal distribution
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Determine the extent of fish losses associated with the operation of the once-through condenser cooling water intakes.  
Sample Dates: Beginning: Oct 1975 End: April 1977  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Deepwater power station (just south of Delaware Memorial Bridge)	109	Specific coordinates not given in study.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Collect, enumerate, identify species impinged on water intake screens over known amount of time.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** Samples  $\geq$  12 hr duration

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate fish species and months during which they were collected. Tabulate monthly distribution of species collected Oct. 1975-April 1977 and number collected. Graphically display number fish impinged/hour for some species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study summarizes results of impingement collections. Ranks 5 most common species (spot, menhaden, bay anchovy, blueback herring and white perch) and discusses their % composition of total, seasonal distributions and average length.

**1. Cited Reference:**

Bain, M.B., and J.L. Bain. 1982. Habit suitability index models: Coastal stocks of striped bass. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-82/10.1. 299 pp.

**2. Principal Investigator:**

**Name:** Mark B. Bain

**Address:** Massachusetts Cooperative Fishery Research Unit  
Univ. of Massachusetts  
Amherst, MA

**Telephone:**

**As of (date):** 1982

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Fish

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Develop habitat suitability index models for striped bass

**Sample Dates:** **Beginning:** **End:**

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Review and synthesize existing data
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
- 8. Data Processing:**

Develop habitat suitability index model from existing data available on striped bass.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**

Reviews data collected by Chittenden (1971) and Murawaski (1969) on the problems of low dissolved oxygen and its influence on eggs, larvae, and juveniles.

1. **Cited Reference:**  
 Biosystems Analysis, Inc. 1990. Results of an ichthyoplankton and juvenile fish survey conducted near the Keystone cogeneration project site: April-August, 1990. Tiburon, CA. (Prepared for Bechtel)
  
2. **Principal Investigator:**  
 Name: Biosystems Analysis Inc.  
 Address: Tiburon, CA 94920  
  
 Telephone: \_\_\_\_\_ As of (date): 12/90
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
 Parameters measured: Fish - abundance, biomass
  
5. **Sample Matrices:**  
 Water-fish communities
  
6. **Sampling Design:**  
 Purpose of Study: Identify and quantify ichthyofauna found in the vicinity of Keystone Cogeneration Plant  
 Sample Dates: Beginning: April 1990 End: Aug. 1990  
 Sample Frequency: 4 days  
 Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Keystone Cogeneration Plant	121-133	Coordinates not given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Beach seine

**Number of Replicate Samples:** Existence of replicates not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate information pertaining to absolute abundance of fish collected and biomass of fish collected.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provides information on status of species composition in the vicinity of Keystone Plant (during the summer months). Also, provides data on biomass of fish species collected.

1. **Cited Reference:**  
 Brundage, H.M. III, and R.E. Meadows. 1982. Occurrence of the endangered shortnose sturgeon, *Acipenser brevirostrum*, in the Delaware River Estuary. *Estuaries* 5(3):203-208.
  
2. **Principal Investigator:**  
**Name:** Harold M. Brundage  
**Address:** Ichthyological Associates  
 Middletown, DE 19709  
**Telephone:** (302)378-9881 **As of (date):** 1982
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Fish-capture records
  
5. **Sample Matrices:**  
 Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Compile all records of shortnose sturgeon  
**Sample Dates:** Beginning: 1817 **End:** Present  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware River Estuary	0 - 217 +	Specific coordinates not given in publication.

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Literature search  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Examine available historical data on the shortnose sturgeon.  
Describe early sturgeon fisheries in the Delaware Estuary.  
Tabulate capture records from 1954-1979 (includes date, location, method of capture and length).
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**  
Provides information on trends of shortnose sturgeon populations in the Delaware River and factors which may influence their abundance and distribution including the sturgeon fishery and seasonal utilization of various parts of the estuary.

1. **Cited Reference:**  
Byrne, D.M. 1985. New Jersey's Estuarine and Marine Environments. An annotated bibliography of scientific literature. Division of Fish Game and Wildlife, Trenton, NJ.
2. **Principal Investigator:**  
Name: D.M. Byrne  
Address: NJ Div. Fish Game & Wildlife  
West Trenton, NJ  
Telephone: (609)628-3218 As of (date): 1985
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:** Bibliography  
**Parameters measured:** Estuarine and Marine references in NJ
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
**Purpose of Study:** Product annotated bibliography of estuarine and marine reports produced in NJ.  
**Sample Dates:** Beginning: End:  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of NJ. Entire Delaware Estuary	0 - 217 +	No specific coordinates given.

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Literature Search  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Literature search for pertinent data and references. Produce annotated bibliography.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**  
Many of the references sited within this publication are related to the Delaware estuaries key biological species and communities.

1. **Cited Reference:**  
Chittenden, M.E. 1971. Status of the striped bass, *Morone saxatilis*, in the Delaware River. Ches. Sci. 12(3):131-136.
2. **Principal Investigator:**  
Name: Mark E. Chittenden  
Address: Virginia Institute of Marine Science  
Gloucester Point, VA 23062  
Telephone: (804)642-7000 As of (date): 1971
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish - abundance, distribution
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Describe reduced collections of striped bass during early 1960s in the Delaware River and comment on historical and recent status.  
Sample Dates: Beginning: 1963 End: 1966  
Sample Frequency: Twice weekly, March-May haul seine  
Fish trap - 1963-1965, trap checked every

few

days.

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Torresdale, PA Lambertville, NJ (14 miles above tidewater) other FW stations	178	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 350' haul seine, 12' or 14' deep, 3" stretch mesh; fish trap at water intake for water treatment plant.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Examines results of various fish surveys. Presents minimum daily dissolved oxygen at 4 locations along the tidal Delaware River. Discusses pollution problems in Philadelphia area and possible effects on striped bass populations.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study provides historical information on the status of striped bass in the Delaware River. Attempts to explain very low abundance in tidal fresh and non-tidal freshwater regions due to serious water quality degradation and corresponding low dissolved oxygen levels.

No striped bass collected in fish traps during the fall from 1963 to 1965, but captured over 9,000 also egg and numerous white perch.

1. **Cited Reference:**  
Chittenden, M.E., Jr. 1974. Trends in the abundance of American shad *Alsoa sapidissima*, in the Delaware River basin. Ches. Sci. 15(2):96-103.
2. **Principal Investigator:**  
Name: Mark E. Chittenden, Jr.  
Address: Virginia Institute of Marine Science  
Gloucester Point, VA 23062  
Telephone: (804)642-7000 As of (date): 1974
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish - pounds landed
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Describe the historical and recent status of American shad in the Delaware River Basin and suggest services of these fish.  
Sample Dates: Beginning: 1800s End: 1968  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware River Basin	0 - 217 +	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Literature search and data manipulation

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Estimates annual commercial landings of American shad in the Delaware River Basin from 1887-1968. Present figure of catch statistics (lbs vs. year landed) and discusses reasons for fluctuations in abundance.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This reference provides historical information on the status of American shad stocks in the Delaware River Basin from the 1880's to 1968. It discusses the large fishery for shad and the drastic decline in landings in the early 1990s. Also, more recent causes for abundance declines are discussed.

Records available from 1890-1901 indicates that 39% of the total Delaware Basin landings came from freshwater portions of Delaware River. 1. Delaware River once supported larger landings of American shad than any other river system (Sykes and Lehman, 1957).

1. **Cited Reference:**  
Chittenden, M.E., Jr. 1975. Dynamics of American shad, *Alosa sapidissima*, runs in the Delaware River. Fish. Bull., 73:487-494.
2. **Principal Investigator:**  
Name: Mark E. Chittenden, Jr.  
Address: Texas A&M University  
College Station, TX  
Telephone: \_\_\_\_\_ As of (date): 1975
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish - age, sex, size, yearclass strength
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: To describe life history information and examine yearclass strengths of American shad during the late 1950s and 1960s.  
Sample Dates: Beginning: 1963 End: 1965  
Sample Frequency: March-May, variable frequency  
Number of Sampling Stations: \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Paulboro, NJ - Marcus Hook, PA	128 - 143	No specific coordinates given in publication.
Other areas in Delaware estuary	and 217 +	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 4 day intervals in 1963, fixed intervals twice weekly other years. Haul seine (107 m x 3.6 m).

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 76 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Determine sex, size, and age composition of collected fish. Determine percentage of repeat spawners. Compare magnitudes of 1961-1968 spawning runs and compare year class strengths during 1956-1964.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

The majority of data presented is for fish collected in the Lambertville area. However, information is presented on the severity of the dissolved oxygen problem to migratory American shad as hundreds of dead shad were collected off Philadelphia during 1965 when spring dissolved oxygen was very low.

1. **Cited Reference:**  
Chittenden, M.E., Jr. 1976. Present and historical spawning grounds and nurseries of American shad, *Alosa sapidissima*, in the Delaware River. Fish. Bull. 74(2):343-352.
2. **Principal Investigator:**  
Name: Mark E. Chittenden, Jr.  
Address: Texas A&M University  
College Station, TX  
Telephone: \_\_\_\_\_ As of (date): 1976
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Fish - abundance, distribution
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Describe spawning period, behavior during spawning recent and historical spawning and nursery grounds.  
Sample Dates: Beginning: 1963 End: 1966  
Sample Frequency: March-May, variable frequency  
Number of Sampling Stations: \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware River (Marcus Hook to NY State line)	128 - 217 +	No specific coordinates given in publication.
Paulsboro, NJ	143	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Sample in Lambertville area at 3-4 day intervals. Haul seine - 107 m x 3.6 m)

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 76 mm mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Describes spawning period by examining reproductive status of fish collected near Lambertville, NJ. Examines important spawning and nursery areas by observations on distribution and abundance of adults and juveniles.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Although most of the data presented was collected in the non-tidal freshwater portion of the Delaware River, Chittenden mentions the utilization of spawning grounds as far south as Marcus Hook and suggests that tidal waters had been historically important. Mentions that tidal water near Philadelphia at this time not suitable for spawning or nursery habitat due to low D.O. Mentions that the Lehigh and Schuylkill rivers were once famous shad streams and the construction of dams after 1820 prevented access to these. Also mentions importance of improving water quality to increasing American shad stocks.

1. **Cited Reference:**  
Cobb, J.N. 1900. The sturgeon fishery of Delaware Bay and River. 825-845 p. In: U.S. Commission of fish and fisheries. Report for the commissioner for 1875-1876.
2. **Principal Investigator:**  
Name: J.N. Cobb  
Address: U.S. Commission of Fish & Fisheries  
  
Telephone: \_\_\_\_\_ As of (date): 1900
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish - number fish caught/net
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Examine the sturgeon fishery of the Delaware estuary.  
Sample Dates: Beginning: 1875 End: 1876  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217 +	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Determine an average catch per net for sturgeon caught 1890 and 1900. Evaluate possible causes of decline in the fishery.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Historical information about the start of the sturgeon fishery (~ 1853). Provides data on fishing seasons and fishing grounds in the Delaware estuary and explains that reduced landings, overfishing and also the destruction of sturgeon by shadgill netters.

Catch/net  
1890-60  
1891-55  
1892-43  
1893-32  
1894-26  
1895-32  
1896-27  
1897-20  
1898-14  
1899-8

**1. Cited Reference:**

Daiber, F.C. 1988. Finfish Resources of the Delaware River Estuary. In: Ecology and Restoration of the Delaware River Basin (Majumder, et al. editors). Pennsylvania Academy of Sciences. 431 pp.

**2. Principal Investigator:**

**Name:** Franklin C. Daiber  
**Address:** College of Marine Studies, University of Delaware  
Newark, DE  
**Telephone:** **As of (date):**

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Fish - status, trends

**5. Sample Matrices:**

Water - fish communities

**6. Sampling Design:**

**Purpose of Study:** Summarize data available on status and trends of finfish resources in the Delaware Estuary.

**Sample Dates:** **Beginning:** **End:**

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 127	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:** Existence of replicate samples  
not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Review available literature on fisheries changes and water quality. Suggest reasons for fishery fluctuations. anthropomorphic changes and water quality. Suggest reasons for fishery fluctuations.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Synopsis of fisheries information in the Delaware Estuary. Discusses status and trends of fishery resources in the Estuary and within the Mid-Atlantic Region. Also examines specific salinity regions within the Estuary and how they relate to fishery distribution.

**1. Cited Reference:**

Daiber, F.C and R.W. Smith. 1971. An analysis of fish populations in the Delaware Bay area. Annual Dingell-Johnson Report. Proj. F-13-R-13. Marine Laboratories, University of Delaware, Lewes, Delaware.

**2. Principal Investigator:**

**Name:** Franklin C. Daiber  
**Address:** University of Delaware  
Newark, DE

**Telephone:** (302)378-9881

**As of (date):** 1971

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Fish - species composition, distribution, relative abundance

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Make useful management recommendations, provide additions to life histories of certain species, and set up program to annually monitor fish populations.

**Sample Dates:** **Beginning:** 1966 **End:** 1970

**Sample Frequency:** Monthly

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware Bay to Liston Point	0 - 72	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Tow trawl 30 minutes per sector (sector - 5 nm long x 4 nm wide). 30' otter trawl

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 3" stretch in body, 2" stretch in cod end.

**Other methodologies:** Determined distances towed by changes in latitudes and longitudes

**Quality control measures:** Measure up to 30 individuals of each species caught.

**8. Data Processing:**

Estimate relative abundance of species collected. Document yearly catch composition (by sector), examine seasonal patterns in species distribution. Provide length-frequency distributions for economically important finfish.

**9. Data Evaluation:**

**10. Companion Studies:**

Daiber and Abbe (1967)  
Daiber and Wockley (1968)  
Daiber and Smith (1970)  
Smith (1987)

**11. Comments:**

This study is part of a long-term trawl survey that has been conducted in the lower portion of the Delaware Estuary since 1966. It provides important baseline data for examining trends in finfish distribution and abundance through time. The Delaware Div. Fish & Wildlife currently continues this trawl survey. Relative abundance determined as total number x frequency of catch.

**1. Cited Reference:**

Daiber, F.C., L.L. Thornton, K.A. Bolster, T.G. Campbell, O.W. Crichton, G.L. Esposito, D.R. Jones, T.M. Tyrąwski. 1976. An atlas of Delaware's wetlands and estuarine resources. Tech. Rep. No. 2. Del. Coastal Management Program. Col. of Marine Studies. Newark, DE.

**2. Principal Investigator:**

**Name:** Franklin C. Daiber  
**Address:** College of Marine Studies, University of Delaware  
Newark, DE  
**Telephone:** (302)378-9881 **As of (date):** 1976

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Fish and bird - distribution

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Provide a comprehensive inventory and assessment of the states wetlands and water resources.

**Sample Dates:** Beginning: 1976 End:

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware State	0 - 127	No specific coordinates given in publication.

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:**  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
  
- 8. Data Processing:**  
Figures show distribution of common fish species and discuss general distribution and life history patterns. Gives brief description of bird families and species which inhabit the wetlands.
  
- 9. Data Evaluation:**
  
- 10. Companion Studies:**
  
- 11. Comments:**  
This study provides information on the distribution fish and invertebrate in Delaware and in Delaware Bay. More general information is provided in the status of bird species.

1. **Cited Reference:**  
De Sylva, D.P., F.A. Kalber, Jr., and C.N. Shuster. 1962. Fishes and ecological conditions in the shore zone of the Delaware River Estuary, with notes on other species collected in deeper water. Univ. Del. Mar. Lab. Info. Ser. Publ. No. 5. 164 p.
2. **Principal Investigator:**  
Name: D.P. de Sylva  
Address: University of Delaware  
Newark, DE  
Telephone: \_\_\_\_\_ As of (date): 1962
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish - abundance, distribution
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Describe fishes and ecological conditions in the near shore areas of the Delaware Bay.  
Sample Dates: Beginning: 1958 End: 1958  
Sample Frequency: Every 2 months  
Number of Sampling Stations: 20, 16 sampled more regularly

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bay Cape May to Penns Grove (16 seine stations)	0 - 117	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Make 3 hauls (approx. 50 yds parallel to beach) with the tide. Haul seine (60' x 4' x 1/4") with 6' bag.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1/8 in. mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Examine species occurrence relative to water temperature, dissolved oxygen and tidal stage. Tabulate species abundance by station. Produce length-frequencies for many species. Documents feeding habits.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This reference provides spatial distribution patterns for species collected in the shore zone of the lower Delaware estuary abundance information is given at each station but can't be directly compared to other stations because amount of effort differed.

1. **Cited Reference:**  
Delaware Basin Fish and Wildlife Management Cooperative. 1980. Strategic fishery management plan for the American shad (*Alosa sapidissima*) in the Delaware River Basin.
  
2. **Principal Investigator:**  
Name: Delaware Basin Fish & Wildlife Management Coop.  
Address: Trenton, NJ  
  
Telephone: (609)883-9500 As of (date): 1980
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Fish - abundance
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Develop a unified interstate management plan for American shad in the Delaware River Basin  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware estuary	0 - 217 +	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Literature search

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Develop a management plan for American shad in the Delaware estuary based on historical and current data.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This report provides information on the abundance and status of shad stocks (past and present) and discusses seasonal migrations of adults and juveniles within the estuary. Also, numerous studies which dealt with shad in the Delaware estuary are discussed.

1. **Cited Reference:**  
Delaware River Basin Commission. 1987. Fish Population Study. DEL USA Project Element 9. West Trenton, NJ.
  
2. **Principal Investigator:**  
**Name:** Delaware River Basin Commission  
**Address:** West Trenton, NJ  
  
**Telephone:** (609)883-9500 **As of (date):**  
1987
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - number fish of each species per zone
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide baseline data for the Fish Suitability Assessment Study.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Zone 2 - Trenton-Neshaminy Creek	186 - 217	Specific coordinates not given in publication.
Zone 3 - Bridgeburg-Chester	153 - 172	
Zone 4 - Schuylkill-Wilmington	114 - 148	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Electrofishing, gill nets (standard and experienced) trap nets, seines and D-frames.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate number of fish of each seines collected in each sample area (gears combined).

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study summarized some of the information collected by the PA Fish Commission during 1984-1986. This reference provides limited data on relative abundance, and distribution of species in the transitional and freshwater portion of the estuary. Raw data obtained during the PA Fish Commission survey was obtained from the Delaware River Basin Commission (Richard Albert, personal communication) and provided more extensive information than is presented in this summary.

1. **Cited Reference:**  
Delaware River Basin Commission. 1988. Fish health and contamination study. DEL USA Project Element 10. West Trenton, NJ.
  
2. **Principal Investigator:**  
**Name:** Delaware River Basin Commission  
**Address:** 25 State Police Drive  
West Trenton, NJ 08628  
**Telephone:** (609)883-9500 **As of (date):** 1988
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - species collected, number collected
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Examine fish health and fish tissue toxics in the upper tidal Delaware estuary.  
**Sample Dates:** **Beginning:** Oct 1986 **End:** July 1987  
**Sample Frequency:**  
**Number of Sampling Stations:** 10

## Sample Locations:

General Location	DRBC River km	Coordinates
Burlington Island	rm-120 193	No specific coordinates given in publication.
Burlington Bristol Br	rm 118 190	
Neshamicy Creek	rm-116 187	
Tacony-Palmyra Br	rm 107 172	
Betsy Ross Br	104 167	
Puty Island	rm 99 159	
Penns Landing	rm 95 153	
Horsehoe Shoals	rm 92 148	
Schuylkill River	rm 92 148	
Paulsboro-Eddystone	84.5 135	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Not fully explained in this report. Gill nets.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate species list and abundance of fishes captured by area. The remainder of the report deals with fish health and contamination, and results of examination of fish collected for this purpose.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study lists number of fish (of each species) captured at each locale, however, no information is available on effort (time of gill net set). Therefore, report should only be used to delineate species distribution in the Delaware Estuary. Numbers of fish collected in each zone cannot be directly compared to other areas.

1. **Cited Reference:**  
Ellis, M.M., B.A. Westfall, D.K. Meyer, and W.S. Platner. 1947.  
Water quality studies of the Delaware River with reference to shad  
migration. US Fish and Wildlife Service Special Scientific Rept.  
38, 56p.
  
2. **Principal Investigator:**  
**Name:** M.M. Ellis  
**Address:** US Fish & Wildlife Service  
  
**Telephone:** (301)498-0330 **As of (date):** 1947
  
3. **Repository of data set or reference:**  
U.S. Fish and Wildlife Service
  
4. **General Data Type:**  
**Parameters measured:** Fish - dissolved oxygen requirements,  
D.O. profiles along Delaware River
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Document the spatial distribution of the  
"pollution block" in the Delaware River and  
examine tolerance of young shad to low D.O.  
**Sample Dates:** Beginning: Spring 1946 End: Oct 1946  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Bridgeport, NJ	130	No specific coordinates given in publication.
Paulboro, NJ	141	
Gloucester, NJ	149	
Delaware River Bridge (to Camden)	155	
Riverton	174.4	
Beverly	135	
Bordentown	209	
Pennsville	107	
Delaware City	97	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Tolerance studies - in laboratory conditions.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Mapped the distribution of the large portion of water containing less than 2 ppm DO. Examine tolerance of juvenile shad to reductions in dissolved oxygen.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provided historical information on water quality conditions existing in the Delaware Estuary and related this information to timing of spawning runs of adult American shad and seaward migration of juveniles in Sept-Oct. Provides more conclusive evidence that the American shad migrations were directly influenced by degraded DO conditions.

Determined that DO's less than 4 ppm can be lethal to juvenile shad.

**1. Cited Reference:**

Fay, C.W., R.J. Neves, and G.B. Pardue. 1983a. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic) -- alewife/blueback herring. U.S. Fish and Wildlife Service, Division of Biological Services. FWS/OBS-82/11.9. U.S. Army Corps of Engineers, TR EL-82-4. 25 p.

**2. Principal Investigator:**

**Name:** Clemon W. Fry  
**Address:** Virginia Polytechnic Inst. and State University  
Blacksburg, VA 24061  
**Telephone:** (703)231-6000 **As of (date):** 1983

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Fish - life history

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Investigate life history and environmental requirements of these species.

**Sample Dates:** **Beginning:** **End:**

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary		No specific coordinates given in publication.
Mid Atlantic coast		

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Literature search and summary

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

- Accumulate life history info from the mid-Atlantic region and summarize data dealing with fishery biology, commercial and recreational fisheries and the ecological role of these species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

"Ecologically important links in estuarine and marine food webs, between zooplankton and top piscivores." This source indicates that the Delaware estuary (in the transitional and freshwater regions) is an important spawning area for bluebacks and alewives. In the freshwater reaches, important recreational fishery. No quantitative information on status of trends of these species.

**1. Cited Reference:**

Fay, C.W., R.J. Neves, and G.B. Pardue. 1983b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic) -- striped bass. U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS-82/11.8 U.S. Army Corps of Engineers, TR EL-82-4. 36 p.

**2. Principal Investigator:**

**Name:** Clemon W. Fay  
**Address:** Virginia Polytechnic Institute and State University  
Blacksburg, VA  
**Telephone:** (703)231-6000 **As of (date):** 1983

**3. Repository of data set or reference:**

U.S. Fish and Wildlife Service

**4. General Data Type:**

**Parameters measured:** Fish - life history

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Investigated life history and environmental requirements of these species.

**Sample Dates:** **Beginning:** **End:**

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware estuary		No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Literature search and summary

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Accumulate life history information from the mid-Atlantic region and summarize data dealing with fishery biology, commercial and recreational value, and the ecological role of the striped bass.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This source indicates the Delaware Estuary (trans and freshwater region) is a spawning and nursery area for juvenile striped bass. This study presents no quantitative information on the status and trends of striped bass in the Delaware estuary.

1. **Cited Reference:**  
Fowler, H.W. 1911. The Fishes of Delaware. Proceedings of the Academy of Natural Sciences of Philadelphia. 3-16 p.
2. **Principal Investigator:**  
Name: Henry W. Fowler  
Address: Academy of Natural Sciences of Philadelphia  
  
Telephone: (215)299-1109 As of (date): 1911
3. **Repository of data set or reference:**  
Academy of Natural Sciences of Philadelphia
4. **General Data Type:**  
Parameters measured: Fish - occurrence
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Document fishes collected in the state of Delaware.  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0 - 127	No specific coordinates given in publication.

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Literature search and collections of fish.
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
- 8. Data Processing:**

Provide taxonomic list of species collected in Delaware and reference the person(s) responsible who first observed this species in the state.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**

Provides qualitative historical information on species collected in the state of Delaware at the turn of the century.

1. **Cited Reference:**  
Friedersdorff, J.W. 1976. Population estimate and relative abundance working on adult American shad stocks in the Delaware River 1969-1976. U.S. Fish and Wildl. Serv. Rosemont, NJ. Spec. Sci. Rept.
  
2. **Principal Investigator:**  
Name: James W. Friedersdorff  
Address: USFWS  
Rosemont, New Jersey  
Telephone: (609)397-0239 As of (date): 1976
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Fish - relative abundance
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Obtain a population estimate of the annual spawning run of American shad in the Delaware River.  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Little Creek	48	No specific coordinates given in publication.
Delaware City	98	
Bristol	191	
Trenton	217	
Ready Point	95	
North of Trenton	217 +	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Stake gill net, drift gill net, anchor gill net, pound net, haul seine, creel census, net weir, log weir, barce trap, fyke trap.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summarize and tabulate 1969-1976 adult American shad catch by gear and location. Evaluate and tabulate fishing gear and stations for tag return program. Use regression analysis to define parameters influencing shad catch. Used Peterson population estimate to determine shad population in 1986.

**9. Data Evaluation:**

**10. Companion Studies:**

Miller et al. (1971, 1972, 1973, 1974, 1975)  
Delaware River anadromous Fish Project  
Luzine (1989 and other years)

**11. Comments:**

1. **Cited Reference:**  
Grimes, C.B. 1983. Nekton (finfish). In: The Delaware estuary: Research as background for estuarine management and development. Univ. of Del. College of Marine Studies. Lewes, DE. Sharp, J.H. (ed).
  
2. **Principal Investigator:**  
**Name:** C.B. Grimes  
**Address:** University of Delaware  
College of Marine Studies  
Lewes, DE  
**Telephone:** (302)645-4000 **As of (date):** 1983
  
3. **Repository of data set or reference:**  
University of Delaware
  
4. **General Data Type:**  
**Parameters measured:** Fish - species list, species dominance, seasonal patterns
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide a general source of information on the ichthyofauna of the Delaware estuary.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217+	No specific coordinates given in publication.

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Literature search  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**  
Summarize and tabulate available data on the finfish in the Delaware Estuary.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Daiber and Smith (1972)  
Smith (1982)  
Seagraves (1982)
- 11. Comments:**  
Most of the data used to describe the ichthyofauna in the Delaware estuary is obtained from trawl surveys in companion studies.

1. **Cited Reference:**  
Hastings, R.W. 1983. A study of the shortnose sturgeon, *Acipenser brevirostrum*) population in the upper tidal Delaware River: Assessment of impacts of maintenance dredging. Center for Coastal and Environmental Studies. Rutgers Univ. New Brunswick, NJ.
  
2. **Principal Investigator:**  
**Name:** Robert W. Hastings  
**Address:** Center for Coastal and Environmental Studies  
Rutgers University  
New Brunswick, NJ  
**Telephone:** (609)785-0074 **As of (date):** 1983
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - distribution, abundance, food habits, population parameters.
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Study the biology of the shortnose sturgeon in the Delaware River in the vicinity of dredging operations, and the potential effects which these operations could have on this endangered species.  
**Sample Dates:** **Beginning:** July 1981 **End:** May 1983  
**Sample Frequency:** Variable  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Trenton	213.7	No specific coordinates given in publication.
Duck Island	207.8	
Newbold Island	200.8	
Burlington Island	191.7	
Hawk Island	179.4	
Petty Island	163.0	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Large mesh gill nets (100 m long (= 5-20 m panels of 4-8" stretch mesh) x 2 or 3 m deep. Small mesh gill nets - (100 m x 2 m, with 4 25-m panels of 1-4" str mesh). 2 otter trawls: 1) 2.9 headrope, 3.8 cm str. mesh body, 2.9 cm cod-end; 2) 4-9 m headrope, 3.8 cm str mesh body, 3.2 cm cod-end.

**Number of Replicate Samples:** Existence of replicate samples not mentioned in publication.

**Area of Volume per Replicates:**  
**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate results of individual studies. Location and time of spawning, distribution and abundance of eggs and larvae. Discuss food habits, sex ratio, age and population structure. Tabulate catch and effort data, water quality data and quantify catches of other species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Gives a thorough examination of the shortnose sturgeon distribution and abundance in the upper tidal portion of the Delaware River during the early 1980s.

1. **Cited Reference:**  
Hastings, R.W., J.C. O'Herron, II, K. Schick, and M.A. Lazzari. 1987. Occurrence and distribution of shortnose sturgeon, *Acipenser brevirostrum*, in the upper tidal Delaware River. *Estuaries*. 10(4):337-341.
  
2. **Principal Investigator:**  
Name: Robert W. Hastings  
Address: Southeastern Louisiana University  
Hammond, Louisiana 70402  
Telephone: \_\_\_\_\_ As of (date): 1987
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Fish - mark-recapture, catch per unit effort (CPUE)
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Present information on the occurrence, distribution and abundance of shortnose sturgeon in the Delaware River between Trenton and Philadelphia.  
Sample Dates: Beginning: July 1981 End: Dec 1984  
Sample Frequency: \_\_\_\_\_  
Number of Sampling Stations: 35

**Sample Locations:**

General Location	DRBC River km	Coordinates
Philadelphia to Trenton	164 - 214	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Phase I - small mesh gill nets, otter trawl, 100 m x 2 m (4-25 m panels of 2.5-10.2 cm stretched mesh) set parallel to current. Phase II - large mesh gill nets, 100 m long x 2-3 m deep x 5-20 m panels of 10.2-20.3 cm stretched mesh fish nets during daylight.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Calculated CPUE for large mesh gill net (# captured/100 m gill net/3-8 hrs). Determined preliminary population estimates for the upper tidal Delaware River.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study provides information on the status of the shortnose sturgeon in the upper tidal Delaware River. Data are presented on the distribution and abundance of this species in the freshwater portion of the estuary.

**1. Cited Reference:**

Himchak, P.J. 1983. Monitoring of the striped bass population in New Jersey. NJ Dept. Environ. Protect., Div. Fish, Game, Wildl. Bur. Mar. Fish.

**2. Principal Investigator:**

**Name:** Peter J. Himchak  
**Address:** NJ Division of Fish, Game and Wildlife

**Telephone:** (609)628-3218 **As of (date):** 1983

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Fish - number, fish/seine, CPUE

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Establish a Delaware River recruitment index for striped bass

**Sample Dates:** **Beginning:** Oct 1982 **End:** Nov 1983

**Sample Frequency:** Monthly August-November

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Penns Beach to Duck Island	106 - 208	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 100 ft beach seine (100' x 6' x 3/8" bar mesh). Trawling and gill netting also performed but recruitment index based on seining of selected beaches.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Reports results for all areas sampled in NJ. Establish a juvenile index for striped bass.

**9. Data Evaluation:**

**10. Companion Studies:**

Himchak (1980-1990)

**11. Comments:**

This paper, which is part of a long term study (1980-1990) provides information on the young-of-year index for striped bass in the Delaware estuary and also relative abundance estimates for other species. In more recent years, the trawling and gill netting has been eliminated.

1. **Cited Reference:**  
Joseph, E.B. 1972. The status of the Sciaenid stocks of the middle Atlantic coast. Ches. Sci. 13:87-100.
2. **Principal Investigator:**  
Name: Edwin B. Joseph  
Address: Virginia Institute of Marine Science  
Gloucester Point, VA  
Telephone: (804)642-7000 As of (date): 1972
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish - landings/year
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Describe the current status of 3 species of sciaenid species in the mid-Atlantic coast.  
Sample Dates: Beginning: 1939 End: 1966  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mid-Atlantic region		

- 7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
  
- 8. Data Processing:**

Examined trends in commercial landings statistics (1939-1966) for 3 species (weakfish, spot and croaker) and suggest some reasons for fluctuations.
  
- 9. Data Evaluation:**
  
- 10. Companion Studies:**
  
- 11. Comments:**

The author suggest some reasons other than overfishing as causing population fluctuations. These included pesticide poisoning, with DDT suggested as influencing weakfish population.

Although this data not directly related to the Delaware Estuary, trends seen in Delaware estuary may be directly related to mid-Atlantic coast trends.

1. **Cited Reference:**  
Lazzari, M.A., J.C. O'Herron II and R.W. Hastings. 1986.  
Occurrence of juvenile Atlantic sturgeon, *Acipenser oxyrinchus*, in the upper tidal Delaware River. *Estuaries* 9:356-361.
2. **Principal Investigator:**  
Name: Mark A. Lazzari  
Address: Center for Coastal and Environmental Studies  
Rutgers University  
Telephone: (609)785-0074 As of (date): 1986
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Present data on the capture of juvenile Atlantic sturgeon in the upper tidal Delaware River  
Sample Dates: Beginning: July 1981 End: Dec. 1984  
Sample Frequency:  
Number of Sampling Stations: 12

**Sample Locations:**

General Location	DRBC River km	Coordinates
Roebing, NJ	201	No specific coordinates given in publication.
Trenton	212	Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Destroy and anchor nets from 4-6 hrs. Set parallel to current. Large mesh gill nets - 100 m x 2 or 3 m. Small mesh gill nets - 100 m x 2 m.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 10.2-20.4 cm stretch mesh and 2.54-10.2 cm stretch mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Present information on age and lengths of sturgeons, length-weight relationships, monthly CPUE for juvenile sturgeon and recapture data for sturgeon collected in the upper tidal reaches of the Delaware estuary.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provides information on the seasonal relative abundance of this species in the upper Delaware estuary. Recapture data suggests that sturgeon utilize this area annually from June-Dec, possibly as a nursery. Reported that in the latter 2 years (1983-1984) the species appeared to be collected in increased numbers.

1. **Cited Reference:**  
 Lesser, C.A. and T.P. Ritchie. 1979. Coastal Fisheries Assistance Program. Coastal Zone Mgt. Del. Div. Fish and Wildl. Dover, DE.
  
2. **Principal Investigator:**  
**Name:** Charles A. Lesser  
**Address:** Delaware Division of Fish & Wildlife  
 Dover, DE  
**Telephone:** (302)739-4782 **As of (date):** 1979
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - pounds landed
  
5. **Sample Matrices:**  
 Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide historical reviews of 14 species of finfish and shellfish which have had a significant impact on the socio-economic aspects of the fishing industry in DE.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0 - 127	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulated commercial finfish and shellfish landings statistics for the state of Delaware. Describe current status and recent history of 14 species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provides historical summary of fisheries in Delaware including landings trends and reasons for fluctuations. Examines hard clams, oysters, blue crabs, lobster, weakfish, bluefish, summer flounder, black seagrasses, Atlantic croaker, striped bass, white perch, shad, American eel, and menhaden.

**1. Cited Reference:**

Loftan, L. 1976. Impingement of fishes on water intake screens of major industrial water users in the Delaware River with particular reference to anadromous fish. p. 305-319. In: Proceedings of a Workshop on American Shad. December 14-16, 1976 in Amherst, Massachusetts.

**2. Principal Investigator:**

**Name:** Larry Loftan

**Address:** USFWS

Rosemont, NJ

**Telephone:** (609)397-0239

**As of (date):** 1976

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Fish - catch per unit effort

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Determine rate of impingement of anadromous fish species, relate influences of water quality parameters and monitor downstream migration of juvenile shad.

**Sample Dates:** Beginning: 1974 End: 1976

**Sample Frequency:**

**Number of Sampling Stations:** 16

**Sample Locations:**

General Location	DRBC River km	Coordinates
Getty Oil Co. Delaware Refinery to Portland Generation Station	98 - 332	No specific coordinates given in publication.

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Checked impingement screens.
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
  
- 8. Data Processing:**

Examined variables affecting CPUE of fish or impingement screens. Tabulated CPUE of anadromous species collected at three power stations (Mercer, Rm-131, Eddystone rm-84, and Deepwater rm-69) during September-December 1975.
  
- 9. Data Evaluation:**
  
- 10. Companion Studies:**
  
- 11. Comments:**

Provides information on spatial distribution of juvenile anadromous species during the fall months. Five most abundant spp collected were menhaden, white perch, blueback herring, and bay anchovy. Alewife and American shad ranked 8th and 12th, respectfully. The larger number of fishes collected at Eddystone may be related to the larger capacity of water withdrawal.

1. **Cited Reference:**  
Lupine, A.J. 1989. The 1989 Delaware River American shad population estimate. Misc. Rep. No. 50. N.J. Div. Fish. Game Wild.
2. **Principal Investigator:**  
Name: Art Lupine  
Address: NJ Freshwater Fisheries Lab  
Lebanon, NJ 08833  
Telephone: (908)236-2118 As of (date): 12/90
3. **Repository of data set or reference:**  
New Jersey Division of Fish, Game, and Wildlife
4. **General Data Type:**  
Parameters measured: Fish - catch per unit of effort, mark-recapture estimates
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Determine a 1989 population estimate for shad collected in the Delaware River.  
Sample Dates: Beginning: Jan. 1989 End: Dec. 1989  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Wilmington to Trenton	114 - 217	No specific coordinates given in publication.
Trenton Northward	215 +	Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Seines

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

This study calculates population estimates for American shad in the upper tidal Delaware Estuary during 1989 and tabulates this data from 1976-1989. Data on juvenile shad production (CPUE) (1979-1989) are presented.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Lists population estimates from 1975-1989. This is a continuation of earlier studies run by NJ Freshwater Fisheries Lab. 1975-1989.

1. **Cited Reference:**  
Martin, C.C. 1972. A biological, chemical, and physical survey of Delaware's tidal streams. F22-R-2. Delaware Division Fish and Wildlife.
  
2. **Principal Investigator:**  
**Name:** Catherine C. Martin  
**Address:** Department of Natural Resources and Environmental Control  
Division of Fish and Wildlife  
**Telephone:** **As of (date):** 1972
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Fish - biological characteristics, abundance
  
5. **Sample Matrices:**  
Water - fish and biological communities
  
6. **Sampling Design:**  
**Purpose of Study:** Determine physical characteristics of tidal creeks flowing into Delaware River and Bay.  
**Sample Dates:** **Beginning:** Jan. 1, 1972 **End:** Dec. 31, 1972  
**Sample Frequency:** Twice yearly  
**Number of Sampling Stations:** 33

**Sample Locations:**

General Location	DRBC River km	Coordinates
Tidal streams and creeks of Delaware Bay and River	0 - 217	No specific coordinates given in publication.

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** 10 ft otter trawl, seining,  
0.5 meter plankton nets.
- Number of Replicate Samples:** Existence of replicate samples not  
mentioned.
- Area of Volume per Replicates:**
- Net, sieve, or filter size:**
- Other methodologies:** 10 minute tows
- Quality control measures:**
- 8. Data Processing:**  
Data presented by sampling date and station. Summary of all species  
collected presented.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Smith (1971)  
Martin (1971)  
de Sylva et al. (1962)
- 11. Comments:**

1. **Cited Reference:**  
Masnik, M.T. and J.H. Wilson. 1980. Assessment of the impacts of the Salem and Hope Creek stations on shortnose sturgeon, *Acipenser brevirostrum* Lesueur. Environmental Specialists Branch, P-234. U.S. Nuclear Regulatory Commission. NUREG-0671. 101 p.
2. **Principal Investigator:**  
Name: M.T. Masnik  
Address: U.S. Nuclear Regulatory Commission  
Washington, D.C.  
Telephone: \_\_\_\_\_ As of (date): 1980
3. **Repository of data set or reference:**  
Nuclear Regulatory Commission
4. **General Data Type:**  
Parameters measured: Fish - distribution, abundance, CPUE
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Assess impacts of nuclear power stations on the shortnose sturgeon population  
Sample Dates: Beginning: \_\_\_\_\_ End: \_\_\_\_\_  
Sample Frequency: \_\_\_\_\_  
Number of Sampling Stations: \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217 +	No specific coordinates given in publication.

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Review available literature on shortnose sturgeon collections
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
  
- 8. Data Processing:**

Accumulated data on Atlantic sturgeon distribution and abundance and assessed the impact that 2 nuclear power stations would have on this endangered species.
  
- 9. Data Evaluation:**
  
- 10. Companion Studies:**
  
- 11. Comments:**

This study provides a thorough review of available data on shortnose sturgeon distribution and abundance in the Delaware estuary. It also provides a historical summary of collections of this species and tabulates available catch and effort data from the Delaware estuary.

1. **Cited Reference:**  
McHugh, J.H. 1981. Marine fisheries of Delaware. Fish. Bull. 79:575-599.
  
2. **Principal Investigator:**  
**Name:** J.L. McHugh  
**Address:** State University of New York  
Stony Brook, NY  
**Telephone:** \_\_\_\_\_ **As of (date):** 1981
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Fish-landings/year, effort/year
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Examine commercial and recreational trends in fisheries in the state of Delaware. Identify reasons for fluctuations in these trends.  
**Sample Dates:** **Beginning:** 1880 **End:** 1977  
**Sample Frequency:** \_\_\_\_\_  
**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0-127	No specific coordinates given in study.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Document trends in commercial fisheries, produce figures showing landings vs. year. and landings vs. amount of gear. Suggest reasons for declines in certain fisheries. Examine recreational fisheries impact.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Trends occurring over time in the State of Delaware should reflect overall trends in the Delaware estuary, and factors causing the fluctuations can also be expanded to the Delaware estuary.

Recreational fisheries may take three times as much as commercial fisheries (1981). Species examined: shellfish-oyster, hard clam, surf clam, blue crab, finfish-menhaden, weakfish, alewives, sturgeon, shad, croaker, spot, striped bass, mullet, American eel, white perch.

1. **Cited Reference:**  
Meldrim, J.W., N.J. Morrisson III and L.O. Horseman. 1977.  
Expected effects of the Deepwater power station thermal plume on selected estuarine fishes. Ichthyological Associates. Ithaca, N.Y.
2. **Principal Investigator:**  
Name: John W. Meldrim  
Address: Ichthyological Associates  
Middletown, DE  
Telephone: (302)378-9881 As of (date): 1977
3. **Repository of data set or reference:**  
Ichthyological Associates, Middletown DE
4. **General Data Type:**  
Parameters measured: Fish-seasonal, number per trawl,  
distribution, percent total catch
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Determine the temporal distribution and abundance of fishes likely to occur near and be influenced by the thermal plume.  
Sample Dates: Beginning: November 1973 End:  
Sept.  
1975  
Sample Frequency: Biweekly  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Deepwater Power Station (just south of Del. Mem.)	110	No specific coordinates given in publication.
Edge Moor Power Station Study 2-8 miles upstream of DPS	114-123	Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Edge Moor Power Station--  
Bottom Trawl-16 ft semiballoon.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1-1/2 stretch mesh body

**Other methodologies:**

Trawl 10 minutes at 1300 rpms in direction of flow. Deepwater Power Station--16 feet other trawl. Divide river into zones. Each study sampled in zones in the vicinity of the power stations.

**Quality control measures:**

**8. Data Processing:**

Describe percent species composition of the catch. Tabulate species abundance and composition by month of capture. Determined and presented mean number of certain species per trawl in the study area. Rank and discuss 7 most common species collected.

**9. Data Evaluation:**

**10. Companion Studies:**

Preddice (1974, 1974a)  
Malzahn (1975)  
Morrison (1976)  
Schuler (1970, 1974, 1974b)

**11. Comments:**

This study reports ecological data on temporal abundance and distribution of fishes, abstracted from studies near Edge Moor Power Station and compares to studies near Artificial Island.

**1. Cited Reference:**

Mercer, L.P. 1983. A biological and fisheries profile of weakfish, *Cynoscion regalis*. North Carolina Department of Natural Resources and Community Development, Division of Marine Fisheries. Special Scientific Report No. 39. 107 pg.

**2. Principal Investigator:**

**Name:** Linda P. Mercer

**Address:** North Carolina Department of Natural Resources  
Morehead City, NC

**Telephone:**

**As of (date):** 1983

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Fish-biology, fisheries

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** To provide an initial step in preparation of profiles and plans for cooperative management of important sciaenid species along the Atlantic coast.

**Sample Dates:** **Beginning:** **End:**

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Atlantic Coast	--	
Discusses weakfish in Delaware Bay	--	No specific coordinates given.

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Literature search and summary
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
- 8. Data Processing:**

Summarize and present available data on distribution life history, population size, fisheries management of weakfish along the Atlantic Coast.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**

This study is not directly related to the Delaware estuary. However, numerous references to studies of weakfish in the Delaware Bay are contained within this report

1. **Cited Reference:**  
Miller, L.W. 1963. Growth, reproduction, and food habits of the white perch, *Roccus americanus* (Gmelin), in the Delaware River Estuary. MS Thesis. University of Delaware.
  
2. **Principal Investigator:**  
Name: Miller, L.W.  
Address: University of Delaware  
Newark, DE  
Telephone: (302)645-4000 As of (date): 1963
  
3. **Repository of data set or reference:**  
University of Delaware, Morris Library, Newark, DE
  
4. **General Data Type:**  
Parameters measured: Fish-distribution
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Determine growth, reproduction, food habits, and distribution of white perch in the Delaware Estuary.  
Sample Dates: Beginning: Aug. 2, 1961 End:  
Aug.  
1,  
1962  
Sample Frequency: Biweekly-spring, summer, and fall  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Silver Creek to Canary Creek and eight stations in between	0-85	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Seines, poison, trawls. 8 ft + 6 ft seines (1/4 in. mesh), Pronox-commercial rotenone with 60 ft x 10 ft x 1 in. stop net. Trawling-35 ft net.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1 in. square mesh

**Other methodologies:** 30 minute tows

**Quality control measures:**

**8. Data Processing:**

Gut content analysis, age and growth studies.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Data doesn't deal with abundance, just distribution. Sampled mainly in tidal tributaries of the Delaware estuary and collected white perch at each site, but no indication of relative abundance given.

1. **Cited Reference:**  
Miller, J.P., J.W. Friedersdorff, H.C. Mears, and C.W. Billingsley. 1973. Delaware River Basin Anadromous Fishery Study. Annual Progress Report. July 1972-December 1972.
2. **Principal Investigator:**  
Name: Joseph P. Miller  
Address: U.S. Fish and Wildlife Service  
Trenton, NJ  
Telephone: (609)883-9500 As of (date): 1973
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD (has 1973, 1975 reports)
4. **General Data Type:**  
Parameters measured: Fish-distribution, seasonal abundance and catch per unit effort.
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Conduct applied research on several aspects of anadromous fish populations in the Delaware River Basin.  
Sample Dates: Beginning: June 1972 End: December 1972  
Sample Frequency: Variable depending on study  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Trenton, NJ (Seine)	217	No specific coordinates given in publication.
New Castle (65) Oldmans Creek (77)	105-124	Same
Petty Island-New Gold Island (125)	166-201	Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Two haul seines: (1) 300 ft x 12 ft, (2) 200 ft x 8 ft with 250 ft lead ropes. 5 ft square modified Cobb Trawl Bottom trawls with 16 ft semi-balloon trawl--1-1/2 in. body and 1/2 in. cod end.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1/2 in. to 1-1/2 in. mesh

**Other methodologies:** 10 minute tows

**Quality control measures:**

**8. Data Processing:**

Examine catch per unit of effort of shad caught at each station. Compare day and night catches. Compare abundance of juvenile shad above and below the pollution block. Produce annual reports.

**9. Data Evaluation:**

**10. Companion Studies:**

Part of a long-term study which was conducted from 1968-1978.

**11. Comments:**

This portion of the study reports on movement and relative abundance of juvenile shad, examines juvenile shad in the pollution zone. Trenton is the southernmost station for the relative abundance work.

**1. Cited Reference:**

Miller, J.P., J.W. Friedersdorff, H.C. Mears, J.P. Hoffman, F.R. Griffiths, R.C. Reichard, and C.W. Billingsley. 1975. Annual Progress Report, Jan. 1973-Jan. 1974: Delaware River Basin Anadromous Fishery Study. Project No. AFS-2-S.

**2. Principal Investigator:**

**Name:** Joseph P. Miller  
**Address:** United States Fish and Wildlife Service  
Dover, DE  
**Telephone:** (609)883-9500 **As of (date):** 12/90

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD (some years)

**4. General Data Type:**

**Parameters measured:** Fish-abundance, distribution, migration

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Conduct applied research on aspects of anadromous fish populations in the Delaware River Basin.

**Sample Dates:** Beginning: January 1973 End: January 1974

**Sample Frequency:**

**Number of Sampling Stations:** Variable

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware River Basin	0-217 +	No specific coordinates given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Numerous methodologies depending on gear type and purpose of specific jobs within the study.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Within each year, numerous studies were conducted. Each of these studies has specific objectives and differing processing techniques.

**9. Data Evaluation:**

**10. Companion Studies:**

Continuation of study which ran 1968 to 1978. Annual progress reports published.

**11. Comments:**

This report is part of a large scale, long-term program designed to examine abundance, distribution, migration patterns, nursery areas, etc., for anadromous fish species in the Delaware River Basin. Much of the data produced in these reports can be used to examine status and trends in the Delaware Estuary.

Delaware River Basin Anadromous Fish Project--Coop between Delaware, New Jersey, New York, Pennsylvania, NMFS, USF and WS. Versar has annual reports from 1980-1984.

1. **Cited Reference:**  
Miller, J.P., F.R. Griffiths, and P.A. Thurston-Rogers. 1982. The American shad (*Alosa sapidissima*). Prepared for the Delaware Basin Fish and Wildlife Management Cooperative.
2. **Principal Investigator:**  
Name: Joseph P. Miller  
Address: United States Fish and Wildlife Service  
Trenton, NJ  
Telephone: (609)883-9500 As of (date): 12/90
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Fish-shad
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: General overview of the American shad in the Delaware River Basin  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware estuary	0-217	No specific coordinates given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Present information on abundance and status of adult and juvenile American shad. Discuss life history parameters and habitat requirements and document mortality factors. Tabulate CPUE for juvenile shad (1971-1975).

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study summarizes available data available on American shad in the Delaware River Basin. This includes abundance and status of juvenile and adult shad and historical fisheries information (1880-1979). Presents CPUE of the shad fishery in Lambertville, NJ from 1925-1980. Also presents commercial catch by state (1880-1979).

1. **Cited Reference:**  
Miller, R.W. 1977. Marine Recreational Fishing in Delaware. Project No. F-29-R, Doc. No. 40-05/78/01/18. Delaware Fish and Wildlife Service, Dover, DE, 28 p.
2. **Principal Investigator:**  
Name: Roy W. Miller  
Address: Delaware Division of Fish and Wildlife  
Dover, DE  
Telephone: (302)739-3441 As of (date): 12/90
3. **Repository of data set or reference:**  
Delaware Division of Fish and Wildlife
4. **General Data Type:**  
Parameters measured: Fish-numbers caught, species composition
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Identify important recreational fisheries in Delaware Bay.  
Sample Dates: Beginning: 1976 End: 1976  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware	0-127	No specific coordinates given in publication.

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:**  
  
    **Number of Replicate Samples:**  
  
    **Area of Volume per Replicates:**  
  
    **Net, sieve, or filter size:**  
  
    **Other methodologies:**  
  
    **Quality control measures:**
8. **Data Processing:**
9. **Data Evaluation:**
10. **Companion Studies:**  
    NMFS Marine Recreational Fisheries Data and Miller (1980).
11. **Comments:**

1. **Cited Reference:**  
Miller, R.W. 1980. Delaware Sport Fishing Survey. Delaware Proj. No. F-39-R. Del. Doc. # 40-05/80-03/02. Division of Fish and Wildlife, Dover, DE. 27 p.
2. **Principal Investigator:**  
Name: Miller, R.W.  
Address: Delaware Division of Fish and Wildlife  
Dover, DE  
Telephone: (302)739-3441                      As of (date): 12/90
3. **Repository of data set or reference:**  
Delaware Division of Fish and Wildlife
4. **General Data Type:**  
Parameters measured: Fish-numbers caught, species composition, effort estimates
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Identify important recreational fisheries in Delaware Bay.  
Sample Dates: Beginning: 1978                      End: 1978  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0-127	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

Number of Replicate Samples:  
Area of Volume per Replicates:  
Net, sieve, or filter size:  
Other methodologies:  
Quality control measures:

**8. Data Processing:**

Estimates total numbers of fish caught. Examines trends in catch statistics, by species. Reviews and compares results of recreational surveys conducted in Delaware in 1963, 1973, 1976.

**9. Data Evaluation:**

**10. Companion Studies:**

NMFS (Marine Recreational Fisheries Survey)  
Miller (1977)

**11. Comments:**

Presentation of results of previous recreational surveys makes it possible to examine changes in catch composition through time. Provided table of changes in species contribution (%) to Marine Landings in Delaware. Also report had chapters on oysters, blue crabs, and hard clams.

	<u>1968</u> <u>(lesser)%</u>	<u>1973(Martin)</u>	<u>1976(Miller)</u>	<u>1978(Miller)</u>
Weakfish	34.5	55.9	39.7	28.5
Summer Fl.	0.1	36.6	10.8	23.1
Bluefish	2.4	3.3	7.9	13.3
Black seabass	14.3	3.6	3.7	3.4
Winter Fl.	15.5	No data	0.9	1.1
Atl. Croaker	No data	0.1	20.4	13.8

1. **Cited Reference:**  
Miller, R.W. 1982a. An overview of the status of river herring (*Alosa aestivalis* and *Alosa pseudoharengus*) in Delaware. Delaware Division of Fish and Wildlife, Dover, DE.
2. **Principal Investigator:**  
Name: Roy W. Miller  
Address: Delaware Division of Fish and Wildlife  
Dover, DE  
Telephone: (302)739-4782                      As of (date): December 1990
3. **Repository of data set or reference:**  
Delaware Division of Fish and Wildlife, Dover, DE
4. **General Data Type:**  
Parameters measured: Fish-pounds landed, CPUE
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Present an overview of river herring (alewives and bluebacks) in the state of Delaware  
Sample Dates:                      Beginning:                      End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware	0-127	No specific coordinates given in publication.

7. **Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:** Literature search and summary  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
8. **Data Processing:**  
Tabulate commercial landings statistics. Present data on species distribution and life history.
9. **Data Evaluation:**
10. **Companion Studies:**
11. **Comments:**  
This paper gives a general summary of distribution of alewives and bluebacks in the state of Delaware and examines commercial landings trends from 1951-1980.

1. **Cited Reference:**  
Miller, R.W. 1982b. An overview of the status of American shad (*Alosa sapidissima*) in Delaware. Delaware Division of Fish and Wildlife. Dover, DE.
2. **Principal Investigator:**  
Name: Roy W. Miller  
Address: Delaware Division of Fish and Wildlife  
Dover, DE  
Telephone: (302)739-3441 As of (date): 1982
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Fish-pounds landed
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Examine status of American shad in Delaware  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0-127	No specific coordinates given in study.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**  
Provide information on the historical shad fisheries, species distribution and life history of American shad. Quantifies gear types used in commercial harvest.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**  
This study presents commercial landings of American shad the state of Delaware (1947-1982).

1. **Cited Reference:**  
Miller, R.W. 1986. Commercial fishing in Delaware in 1986. Delaware Division of Fish and Wildlife, Dover, DE.
2. **Principal Investigator:**  
**Name:** Roy W. Miller  
**Address:** Delaware Division of Fish and Wildlife  
Dover, DE  
**Telephone:** (302)739-3441 **As of (date):** 12/90
3. **Repository of data set or reference:**  
Delaware Division of Fish and Wildlife
4. **General Data Type:**  
**Parameters measured:** Fish-pounds landed
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
**Purpose of Study:** Monitor commercial finfish landings in the state of Delaware.  
**Sample Dates:** **Beginning:** January 1986 **End:** December 1986  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0-127	Specific coordinates not given.

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:**  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**  
This study tabulates commercial landings (in lbs.) for each species. Also distributes this data by gear type, area and month. Tabulates gill net effort by month in Delaware.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Miller (1987) and Miller (1988).
- 11. Comments:**  
This study provides total State landings of commercial species. Should be identical to NMFS commercial landings data. Also provides valuable data on area fish were caught and seasonality of capture. Would be interesting to compare commercial landings in pounds in the entire State with landings reported for the Delaware River for key species.

1. **Cited Reference:**  
Miller, R.W. 1988. Commercial fishing in Delaware in 1988. Delaware Division of Fish and Wildlife, Dover, DE.
2. **Principal Investigator:**  
Name: Roy W. Miller  
Address: Delaware Division of Fish and Wildlife  
Dover, DE  
Telephone: (302)739-3441 As of (date): 12/90
3. **Repository of data set or reference:**  
Delaware Division of Fish and Wildlife
4. **General Data Type:**  
Parameters measured: Fish-pounds landed
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Monitor commercial finfish landings in the State of Delaware.  
Sample Dates: Beginning: Jan 1988 End: Dec 1988  
Sample Frequency: Monthly  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0-127	Specific coordinates not given.

- 7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
- 8. Data Processing:**

This study tabulates commercial landings (in lbs.) for each species. Also distributes this data by gear type, area and month. Tabulates gill net effort by month in Delaware.
- 9. Data Evaluation:**
- 10. Companion Studies:**

Miller (19867)
- 11. Comments:**

This study provides total State landings of commercial species. Should be identical to NMFS commercial landings data. Also provides valuable data on area fish were caught and seasonality of capture. Would be interesting to compare commercial landings in pounds in the entire State with landings reported for the Delaware River for key species.

**1. Cited Reference:**

Moran, R.L. 1974. Occurrence and size-class distributions of fishes at Augustine Beach, Delaware and at Sunken Ship Cove near Artificial Island, New Jersey on the Delaware River, 1971. 53 p. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Ichthyological Associates, Middletown, Delaware.

**2. Principal Investigator:**

**Name:** V.J. Schuler  
**Address:** Ichthyological Associates  
Middletown, Delaware

**Telephone:** \_\_\_\_\_ **As of (date):** 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Fish - abundance, distribution

**5. Sample Matrices:**

Water - fish communities

**6. Sampling Design:**

**Purpose of Study:** Examine occurrence and distribution of fishes in the vicinity of Artificial Island.

**Sample Dates:** **Beginning:** January 1971 **End:** December 1971

**Sample Frequency:** Biweekly

**Number of Sampling Stations:** Variable

**Sample Locations:**

General Location	DRBC River km	Coordinates
Augustine Beach and Sunken Ship Cove	70 - 72	Specific coordinates not given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 16 ft semi-balloon Otter trawl, beach seine and bag seine

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1/4 - 1/2 in. mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Data presented by sampling date and station. Fish presented by occurrence ranks.

**9. Data Evaluation:**

**10. Companion Studies:**

Preddice (1974a, 1974b)

Schuler (1971)

Public Service Electric and Gas (1980)

**11. Comments:**

1. **Cited Reference:**  
Musick, J.L. and L.P. Mercer. 1977. Seasonal distribution of the black sea bass, *Centropristis striata*, in the Middle Atlantic bight with comments on the ecology and fisheries of the species. Trans. Am. Fish. Soc. 106:13-25.
  
2. **Principal Investigator:**  
**Name:** John A. Musick  
**Address:** Virginia Institute of Marine Science  
 Gloucester Point, VA  
**Telephone:** (804)642-7000 **As of (date):** 1977
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Fish-distribution
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Quantitatively describe the seasonal availability of sea bass in the mid-Atlantic Bight.  
**Sample Dates:** Beginning: 1967 End: 1972  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mid-Atlantic Bight	--	
Lower Delaware Bay	--	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Collected information from two major groundfish surveys.

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Document estuarine and continental shelf distribution of the black sea bass. Report on fauna commonly associated with this species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Young black sea bass occupy high salinity areas within the Delaware estuary in July. They migrate out of the estuarine nursery grounds in autumn and migrate southwestward.

1. **Cited Reference:**  
National Marine Fisheries Service. 1979-1989. Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts. Washington, DC.
2. **Principal Investigator:**  
Name: National Marine Fisheries Service  
Address: Laurel, MD  
Telephone: (301) 427-2328 As of (date): 1989
3. **Repository of data set or reference:**  
National Marine Fisheries Service, Washington, DC
4. **General Data Type:**  
Parameters measured: Fish-creel census, species data
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Stratified random-summarize and monitor marine recreational finfish landings.  
Sample Dates: Beginning: 1979 End: Present  
Sample Frequency: Bimonthly (except January/February)  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Marine Waters, State of Delaware and New Jersey		Specific coordinates not given.

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:**  
  
**Number of Replicate Samples:**  
**Area of Volume per Replicates:**  
**Net, sieve, or filter size:**  
**Other methodologies:**  
**Quality control measures:**
- 8. Data Processing:**  
Tabulate marine recreational fishing statistics, by species, state and region.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**

1. **Cited Reference:**  
National Marine Fisheries Service. Fishery Statistics of the United States. Numerous volumes dating from 1880s to 1989.
  
2. **Principal Investigator:**  
**Name:** Richard Schween  
**Address:** Laurel, MD  
  
**Telephone:** (301)427-2328 **As of (date):** 12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Fish-commercial catch
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide quantitative estimates of commercial fisheries catch.  
**Sample Dates:** **Beginning:** 1880s **End:** 1989  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Port samples and trip tickets

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Collect quantitative data on commercial fisheries landings data.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1880-1976 data obtained on microfiche from NMFS. 1962-1989 data obtained in ASCII format from Dick Schween at National Marine Fisheries Service in Laurel, MD. Data useful in examining fisheries trends over time in the Delaware Estuary.

1. **Cited Reference:**  
 Pennsylvania Fish Commission. Unpublished data: Obtained from Dick Albert, Delaware River Basin Commission. West Trenton, New Jersey.
  
2. **Principal Investigator:**  
**Name:** Mike Kaufman  
**Address:** West Trenton, NJ  
**Telephone:** (215)847-2442 **As of (date):** 12/90
  
3. **Repository of data set or reference:**  
 Delaware River Basin Commission, West Trenton, NJ
  
4. **General Data Type:**  
**Parameters measured:** Fish-abundance, catch per unit effort
  
5. **Sample Matrices:**  
 Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide baseline data on the status of fish species in the Delaware River.  
**Sample Dates:** **Beginning:** 1984 **End:** 1986  
**Sample Frequency:** Variable  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Marcus Hook to Trenton	128 - 217	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Seines, gill nets

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Collected quantitative data on fishes in the Marcus Hook to Trenton area.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

These data are unpublished and were obtained through the Delaware River Basin Commission. They provide useful information on the status of many species in the Delaware River.

1. **Cited Reference:**  
 Perlmetter, A. 1959. Changes in the populations of fishes and in their fisheries in the Middle Atlantic and Chesapeake regions, 1930-1955. Trans. N.Y. Acad. Sci., Ser. II, 21:484-496.
  
2. **Principal Investigator:**  
**Name:** Alfred Perlmutter  
**Address:** New York University  
 New York, NY  
**Telephone:** \_\_\_\_\_ **As of (date):** 1959
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish-pounds landed
  
5. **Sample Matrices:**  
 Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Document changes in fish populations and their fisheries.  
**Sample Dates:** Beginning: 1930 End: 1955  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mid-Atlantic States	--	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Utilize commercial fisheries data to present trends in landings.

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

This study produced figures of annual landings (1930-1955), and examines percent gear composition and percent species composition of the catch. Presents annual catch of certain species by state of capture.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study reports catch of certain species in the mid-Atlantic region during 1930-1955. Although the Delaware estuary is not directly addressed, many trends and factors influencing catch rates are applicable. For example-notes increase in scup landings from 1930-1955. The author cites this as not as an increase in abundance, but an increase in acceptability of this species from the consumers. This type of data helps to identify reasons for population fluctuations that are actually population size changes.

**1. Cited Reference:**

Phillips, J.M., M.T. Huish, J.H. Kirby, and D.P. Morgan. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)-spot. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.98) U.S. Army Corps of Engineers, TR EL-82-4. 13 p.

**2. Principal Investigator:**

Name: J.M. Phillips  
Address:

Telephone:

As of (date): 1989

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

Parameters measured: Fish-distribution

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

Purpose of Study: Provide information on life history and environmental requirements of spot.

Sample Dates: Beginning: End:

Sample Frequency:

Number of Sampling Stations:

Sample Locations:

General Location	DRBC River km	Coordinates
Mid-Atlantic region	-	

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Literature search and summary.
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
  
- 8. Data Processing:**

Accumulate data on spot and present information on their distribution, life history, growth rates, status as commercial and sport fisheries and examine ecological role and environmental requirements.
  
- 9. Data Evaluation:**
  
- 10. Companion Studies:**
  
- 11. Comments:**

Diagrams present the distribution of spot in the Delaware estuary and in the mid-Atlantic region.

1. **Cited Reference:**  
Preddice, T.L. 1974. Fishes taken by trawl and seine. In: An ecological study of the Delaware River in the vicinity of the Edge Moore Power Station. Progress report for the period October through December 1973. Ichthyological Associates, Inc. 109 pp.
2. **Principal Investigator:**  
Name: T.L. Preddice  
Address: Ichthyological Associates  
Wilmington, DE  
Telephone: (302)378-9881 As of (date): 1973
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish-catch composition, rank, seasonal distribution, CPUE.
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Investigate the impact of station operation on the aquatic environment  
Sample Dates: Beginning: Oct. 1973 End: Dec. 1973  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Edge Moor Power Station Pigeon Pt. (DE) to Stoney Creek (DE)	113 - 121	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 16' balloon otter trawl.  
Seine - 10' x 4' x 1/8" mesh.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** Body of 1 1/2" stretch mesh, cod end 1/2" stretch mesh.

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Report results of fish collections. Tabulate collection data.  
Estimate CPUE for trawl data.

**9. Data Evaluation:**

**10. Companion Studies:**

Preddice and Molin (1974)

**11. Comments:**

This study provides data on the status of fish species near Edge Moor power plant and contains impingement data.

**1. Cited Reference:**

Preddice, T.L. and T.B. Molin. 1974a. The impingement of fishes and macroinvertebrates on the vertical traveling screens. In: An ecological study of the Delaware River in the vicinity of the Edge Moor Power Station. Progress Rept. Jan-May, 1974. Ichthyological Associates, Inc. 295p.

**2. Principal Investigator:**

**Name:** Timothy L. Preddice  
**Address:** Ichthyological Associates, Inc.  
c/o Edge Moor Power Station  
800 King St.  
Wilmington, Delaware 19899

**Telephone:**

**As of (date):** 1974

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Fish-season abundance and distribution

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Identification of fishes in the vicinity of Edge Moor Power Station and determination of seasonal variation in abundance and distribution.

**Sample Dates:** Beginning: Jan 1974 End: May 1974

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 13 zones trawl, 6 seine zones

**Sample Locations:**

General Location	DRBC River km	Coordinates
In the vicinity of Edge Moor Power Station	~ 118	No specific coordinates given in publication. See Fig. 1.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Nylon minnow seine (1/8 inch mesh), 16 ft semi-balloon otter trawl, gill net.

**Number of Replicate Samples:** Up to 5

**Area of Volume per Replicates:** Not given

**Net, sieve, or filter size:** Variable

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Data presented by zone and sampling date.

**9. Data Evaluation:**

**10. Companion Studies:**

Ichthyological Associates, 1974

**11. Comments:**

1. **Cited Reference:**  
 Preddice, T.L. and T.B. Molin. 1974b. The abundance and distribution of post larval fishes. In: An ecological study of the Delaware River in the vicinity of the Edge Moor power station. Progress Report Jan-May, 1974. 295.
  
2. **Principal Investigator:**  
**Name:** Timothy L. Preddice  
**Address:** Ichthyological Associates  
 Wilmington, DE  
**Telephone:** (302)378-9881 **As of (date):** 1974
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish-catch composition, rank, seasonal distribution, CPUE
  
5. **Sample Matrices:**  
 Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Investigate the ichthyofauna in the pre-operational phase of Salem Nuclear Generating Station.  
**Sample Dates:** Beginning: Jan 1974 End: May 1974  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Edge Moore Power Station	113 - 121	Specific coordinates not given.
Pigeon Pt. DE to Stoney Creek, DE		Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Trawl -- 16' semi-balloon otter trawl. Seine -- 10' x 4' x 1/8 " mesh. Gill nets.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1/8 in. mesh

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Report results of fish collections. Tabulate collection data. Estimate catch per unit of effort for trawl data.

**9. Data Evaluation:**

**10. Companion Studies:**

Preddice, 1974

**11. Comments:**

This study provides data on the status of fish species near Edge Moor Power Station and contains impingement data.

1. **Cited Reference:**  
Price, K.S., R.A. Beck, S.M. Tweed, and C.E. Epifanio. 1983. Fisheries In: The Delaware Estuary: Rediscovering a forgotten resource. Pennock and Bryant eds. University of Delaware Sea Grant, Newark, DE.
2. **Principal Investigator:**  
Name: Kent S. Price  
Address: University of Delaware  
Lewes, DE  
Telephone: (302)645-4000 As of (date): Dec 1990
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish-landings trends, historical trends
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Summarize information on the fisheries in the Delaware estuary.  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217	Specific coordinates not given.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Produce figures of commercial landings of pertinent species through time. Discuss the history of 3 important fisheries in the Delaware estuary (shad, menhaden, sturgeon) and discuss status of the fisheries (commercial and recreational) in the estuary.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This publication is a good general reference for fisheries in the Delaware Estuary. Section by Susan Ford on MSX and oyster declines, provides good historical background.

1. **Cited Reference:**  
Price, K.S. and B.J. Dinkins. 1986. Fisheries fluctuations - Can we separate manmade effects from natural effects on the abundance of Delaware Bay Fisheries? Delaware Estuary Situation Permits, University of Del. Sea Grant College Program, Newark, DE.
  
2. **Principal Investigator:**  
Name: Kent S. Price  
Address: University of Delaware  
Lewes, Delaware  
Telephone: (302)645-4000 As of (date): 1986
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Fish-abundance
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Present information on several factors which may influence fisheries fluctuation.  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217 +	Specific coordinates not given.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

This study explains problems associated with separating manmade and natural influences on fishery fluctuations. Presents information on individual components and how they may cause fluctuations in a particular species abundance.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study examines a wide variety of potential influences on fisheries populations. This includes both natural and man-made sources. Many times fishery fluctuations are blamed solely on overfishing, this paper provides alternatives sources of changing fish population.

1. **Cited Reference:**  
Public Service Electric and Gas Company. 1979. Effect of the cooling water intake structure-entrainment and impingement of fishes. Burlington Generating Station. Prepared by Ichthyological Associates, Ithaca, NY.
2. **Principal Investigator:**  
Name: Public Service Electric and Gas Company  
Address: Ichthyological Associates, Inc.  
Ithaca, NY  
Telephone: (607)533-8801 As of (date): 1979
3. **Repository of data set or reference:**  
Ichthyological Associates, Inc.
4. **General Data Type:**  
Parameters measured: Fish-abundance
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Random-examine the impact of entrainment and impingement on local fish populations.  
Sample Dates: Beginning: End:  
Sample Frequency: Once/month - Jan., Feb., Mar., Nov., Dec.  
Twice/month - June, July, Oct., Sept.  
Four/month - Apr., May, Aug.  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Burlington Generating Station	190	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Check impingement screens every 12, 24, or 2-hour period. Also use 7.6 x 1.2 m beach seine (had 1.2 x 1.2 m bag).

Trawl - 4.9 m - semiballoon trawl.  
3.8 cm stretch mesh body  
3.1 cm stretch mesh cod-end with 1-3 cm innerliner.  
Second trawl for night--7.6 m trawl.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:** Tow trawl 2 minutes in direction of current.

Tow at 1200 rpms.

**Quality control measures:**

**8. Data Processing:**

Summarize results of impingement studies: report number of species, number of individuals, and average densities/month. Reported most abundant species by gear. For important species they reported the percentage of total numbers of fish they represented and also the percentage of biomass. For impingement, they also discuss the potential damage to the populations. Tabulate raw data for trawls and seines.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study provides information on abundance of species in the vicinity of Burlington Generation Station.

1. **Cited Reference:**  
Public Service Electric and Gas Co. 1980. An ecological study of the Delaware River near Artificial Island, 1968-1976. A summary. Public Service Electric and Gas Co., Newark, NJ. 303 p.
  
2. **Principal Investigator:**  
Name: Public Service Electric and Gas Co.  
Address: Newark, NJ  
  
Telephone: (201)621-7500 As of (date): 1980
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Fish-catch per unit effort (CPUE)
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Provide baseline data on abundance and distribution of species near Artificial Island prior to startup of the generating station.  
Sample Dates: Beginning: 1968 End: 1976  
Sample Frequency: Variable  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Artificial Island	79 - 92	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Trawls, 2.7 m, 4.9 m, 7.6m. Seines 3 x 1.2 m, 7.67 x 1.2 m, 68.6 x 3.0 m. Gill net 2 x 183 m (7.9 cm stretch mesh), 2 x 91 m (7.9 cm stretch mesh), 3 x 183 m (14 cm stretch), 6 x 183 m (14 cm stretch), 3 x 91 m + 6 x 91 m (14 cm stretch).

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate sampling gear and years used. Summarize results of ichthyoplankton collections, river trawling, river seining, gill netting and creek trawl and seine projects. Discuss common species. Graphically display seasonal catch per unit effort for "important" species and annual.

**9. Data Evaluation:**

**10. Companion Studies:**

Raney et al. (1969)  
Schuler et al. (1970-1977)

**11. Comments:**

This report summarizes data collected in the pre-operational progress reports. Discusses in detail the following species. American eel, blueback herring, alewife, American shad, Atlantic menhaden, bay anchovy, mummichog, tidewater silverside, Atlantic silverside, white perch, striped bass, weakfish, spot. Atlantic croaker, naked goby and hogchoker.

1. **Cited Reference:**  
Public Service Electric and Gas Company. 1984a. Salem 316(b) Demonstration. Sections 1-5. NPDES Permit No. NJ0005622. Prepared by Public Service Electric and Gas. Newark, NJ.
  
2. **Principal Investigator:**  
**Name:** Public Service Electric and Gas Company  
**Address:** Newark, NJ  
  
**Telephone:** (201)621-7500 **As of (date):** 1984
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish-distribution, abundance
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** To determine the effects of Salem's cooling water intakes on the ecology of the source waterbody.  
**Sample Dates:** **Beginning:** 1970 **End:** 1976  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Artificial Island	79 - 92	Specific coordinates not given.

- 7. Sampling Methodologies:**
  - Sample Gear, Methods and Analyses:** Described in individual progress reports.
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
  
- 8. Data Processing:**

Summarize data collected on 9 target species during the pre-operational phase. Give brief synopsis on distribution and abundance of these species.
  
- 9. Data Evaluation:**
  
- 10. Companion Studies:**

PSE&G 1982, 1983.
  
- 11. Comments:**

Appendices containing a synthesis of information from literature searches and field studies in the vicinity of Artificial Island. The 9 fish target species each has a separate appendix.

1. **Cited Reference:**  
Public Service Electric and Gas Company. 1984b. Alewife: information on natural history, with reference to occurrence in the Delaware River and involvement with the Salem Nuclear Generating Station. Salem Nuclear Generating Station 316(b) Demonstration Appendix V. PSE&G, Newark, NJ.
  
2. **Principal Investigator:**  
**Name:** Public Service Electric & Gas Co.  
**Address:** Newark, NJ  
  
**Telephone:** (201)621-7500 **As of (date):** 1984
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish-abundance, distribution.
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Summarize available information and data on alewives near Salem Nuclear generating station.  
**Sample Dates: Beginning:** 1968 **End:** 1981  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Artificial Island Salem Plant	79 - 92	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Literature search and summary of field sampling results.

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summarize results of ecological studies in the vicinity of Artificial Island. Present data on taxonomy morphology, distribution, reproduction, growth, behavior, population dynamics, fishing and impingement and entrainment of this species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Other Appendices which should be cited in same manner as this report:

Appendix	Species	Year
3	Shad	1982
5	Alewife	1984
6	Blueback	1982
7	Spot	1984
8	Croaker	1984
9	Striped Bass	1984
10	White Perch	1984
11	Weakfish	1984
12	Bay Anchovy	1984

**1. Cited Reference:**

Rogers, S.G., and M.J. Van Den Avyle. 1989. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic) -- Atlantic menhaden. U.S. Fish and Wildlife Service, Biol. Rep. 82(11.108). U.S. Army Corps of Engineers, TR-EL-82-4. 23 p.

**2. Principal Investigator:**

**Name:** S. Gordon Rogers  
**Address:** School of Forest and Resources  
University of Georgia

**Telephone:** \_\_\_\_\_ **As of (date):** 1989

**3. Repository of data set or reference:**

U.S. Fish and Wildlife Service

**4. General Data Type:**

**Parameters measured:** Fish-distribution, life history.

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Provide information on life history of Atlantic menhaden in the mid-Atlantic region.

**Sample Dates:** Beginning: \_\_\_\_\_ End: \_\_\_\_\_

**Sample Frequency:** \_\_\_\_\_

**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Atlantic coast	--	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Literature search and summary

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Summarize available information on Atlantic menhaden and discuss life history, growth, ecology, environmental requirements and the fishery.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This report provides a short summary of the Atlantic Coast menhaden fishery and discusses the distribution of the species.

1. **Cited Reference:**  
 Rohde, F.C. 1974a. Abundance and distribution of fishes at Augustine Beach, Delaware and at Sunken Ship Cove near Artificial Island, New Jersey on the Delaware River, 1971. 48 p. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Ichthyological Associates, Middletown, DE.
  
2. **Principal Investigator:**  
**Name:** V.J. Schuler  
**Address:** Ichthyological Associates, Inc.  
 Middletown, DE  
**Telephone:** \_\_\_\_\_ **As of (date):** 1974
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Fish - abundance and distribution
  
5. **Sample Matrices:**  
 Water - fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Compare species composition of fishes at Augustine Beach and near Sunken Ship Cover near Artificial Island.  
**Sample Dates:** **Beginning:** January 1971 **End:** December 1971  
**Sample Frequency:** 200 collections  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Augustine Beach and Sunken Ship Cove	70 - 72	No specific coordinates given in publication.

- 7. Sampling Methodologies:**
- Sample Gear, Methods and Analyses:** 16 ft. Otter trawl, flat seine and bag seines
- Number of Replicate Samples:** 2 for trawls, 3-4 for seines
- Area of Volume per Replicates:** Not given
- Net, sieve, or filter size:** 1/8 - 1/2 in. mesh
- Other methodologies:** 5 and 10 minute trawls
- Quality control measures:**
- 8. Data Processing:**  
Data presented by sampling date and station. Fish presented by rank of occurrence.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Preddice (1974a, 1974b)  
Schuler (1971)  
Public Service Electric and Gas (1980)
- 11. Comments:**

1. **Cited Reference:**  
Rohde, F.C. 1974b. Abundance and distribution of fishes in Appoquinimink and Alloway creeks, two low-salinity tidal tributaries of the Delaware River near Artificial Island in 1971. 69 p. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Ichthyological Associates, Middletown, DE.
  
2. **Principal Investigator:**  
Name: V.J. Schuler  
Address: Ichthyological Associates, Inc.  
Middletown, DE  
Telephone: \_\_\_\_\_ As of (date): 1974
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Fish - abundance and distribution
  
5. **Sample Matrices:**  
Water - fish communities
  
6. **Sampling Design:**  
Purpose of Study: Determine abundance and distribution of fishes in Alloway and Appoquinimink Creeks near the Delaware River.  
  
Sample Dates: Beginning: January 1971 End: December 1971  
Sample Frequency:  
Number of Sampling Stations: 10

**Sample Locations:**

General Location	DRBC River km	Coordinates
Appoquinimink and Alloway Creeks	≈ 80	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 10 ft. minnow seine. 9 ft  
semi-balloon Otter trawl

**Number of Replicate Samples:** Existence of replicate samples  
not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1/8 in. mesh

**Other methodologies:** 5 minute hauls made with the  
tide

**Quality control measures:**

**8. Data Processing:**

Data presented by sampling date and station. Fish presented by  
rank collected.

**9. Data Evaluation:**

**10. Companion Studies:**

Smith (1971)

Schuler (1971)

Public Service Electric and Gas (1980)

**11. Comments:**

**1. Cited Reference:**

Rohde, F.C. and V.J. Schuler. 1974. Abundance and distribution of fishes in the Delaware River in the vicinity of Artificial Island, 1971, 232 p. In: An ecological study of the Delaware River in the vicinity of Artificial Island. Ichthyological Associates, Inc., Middletown, Delaware.

**2. Principal Investigator:**

**Name:** F. C. Rohde

**Address:** Ichthyological Associates  
Middletown, DE

**Telephone:** (302)378-9881

**As of (date):** 1974

**3. Repository of data set or reference:**

Ichthyological Associates, Inc., Middletown, Delaware

**4. General Data Type:**

**Parameters measured:** Fish - occurrence, distribution, abundance

**5. Sample Matrices:**

Water - fish communities

**6. Sampling Design:**

**Purpose of Study:** Collect baseline data in the vicinity of Artificial Island, which can be compared to data collected after the plant opens.

**Sample Dates:** Beginning: January 1971 End: December 1971

**Sample Frequency:** Monthly

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Artificial Island	79 - 92	No specific coordinates given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 2 Seines: 1) 10ft x 4ft x 1/4in.

Trawl-16ft balloon

Gill Nets-200 yd x (10ft or 20ft deep)

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** Mesh = 5-1/2 or 3-1/8 in.

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate and present data collected during 1972 with seines, trawls and gill nets. Report occurrence, distribution, and relative abundance of the species.

**9. Data Evaluation:**

**10. Companion Studies:**

Raney et al. (1969)  
Schuler (1974)

**11. Comments:**

Summarize catch statistics for collections with each gear. Provide information on status of fishes in the Artificial Island during 1971.

1. **Cited Reference:**  
Schuler, V.J. 1971. An ecological study of the Delaware River in the vicinity of Artificial Island. Progress report for the period January-December 1970. Ichthyological Associates, Inc., Ithaca, NY. 384 pp.
  
2. **Principal Investigator:**  
**Name:** Victor J. Schuler  
**Address:** Ichthyological Associates, Inc.  
Middletown, Delaware  
**Telephone:** (302)378-9881 **As of (date):** 1971
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - number/trawl
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Collect biological and physicochemical baseline data which can be compared with data collected after Salem Nuclear Generating Plant opens.  
**Sample Dates:** Beginning: Jan 1970 End: Dec 1970  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Salem Nuclear Power Plant (and 4 miles North and South of the plant)	79 - 92	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 10 ft x 4 ft x 1/4 in. seine, 25 ft x 4 ft x 1/4 in. seine, 10 ft x 225 ft x 3/8 in. seine. 16 ft balloon trawl. Gill nets - 200 yd long x 10 ft or 20 ft deep.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** Mesh = 5-1/2 in. or 3-1/8 in.

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Compute occurrence, relative abundance, and distribution of species. Tabulates and presents data collected during 1970 with seines, trawls, and gill nets.

**9. Data Evaluation:**

**10. Companion Studies:**

Raney, et al. (1969)  
Schuler (1974)

**11. Comments:**

Summarizes catch statistics for collections with each of the gears. This study provides some information on the distribution, occurrence, and relative abundance of species collected during 1970 in the Artificial Island area.

1. **Cited Reference:**  
Schuler, V.J. 1974. An ecological study of the Delaware River in the vicinity of Artificial Island. Progress report for the period January-December 1972. Ichthyological Associates, Inc., Ithaca, New York. 571 pp.
  
2. **Principal Investigator:**  
**Name:** Victor J. Schuler  
**Address:** Ichthyological Associates, Inc.  
Middletown, Delaware  
**Telephone:** (302)378-9881 **As of (date):** 1974
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - occurrence, distribution, abundance
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Collect baseline data in the vicinity of Artificial Island which can be compared to data collected when the nuclear plant opens.  
**Sample Dates:** **Beginning:** January 1972 **End:** December 1972  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Salem Nuclear Power Plant (and 4 miles North and South)	79 - 92	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 2 seines: 1) 10 ft x 4 ft x 1/4 in.;  
2) 25 ft x 4 ft x 1/4 in.  
Trawl - 16 ft balloon trawl  
Gill nets - 200 yards x (10 ft or 20 ft deep)

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** Mesh = 5-1/2 in. or 3-1/8 in.

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate and present data collected during 1972 with seines, trawls and gill nets. Report occurrence, distribution, and relative abundance of species. Also present data on ichthyoplankton benthos and zooplankton.

**9. Data Evaluation:**

**10. Companion Studies:**

Raney, et al. (1969)  
Schuler (1974)

**11. Comments:**

Summarizes catch statistics for collections with each gear. Provides information on the status of species collected during 1972 in the Artificial Island area.

1. **Cited Reference:**  
Seagraves, R.J. 1981. A comparative study of the size and age composition and growth rate of weakfish (*Cynoscion regalis*) populations in Delaware Bay. MS Thesis. University of Delaware. Newark, Delaware, 102 p.
  
2. **Principal Investigator:**  
**Name:** Richard J. Seagraves  
**Address:** Delaware Division of Fish and Wildlife  
Dover, Delaware  
**Telephone:** (302)739-4782 **As of (date):** 12/90
  
3. **Repository of data set or reference:**  
University of Delaware - Marine Studies Laboratory, Dover, DE
  
4. **General Data Type:**  
**Parameters measured:** Fish - density and catch per unit effort
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Examine life history and growth characteristics of weakfish in Delaware Bay.  
**Sample Dates:** **Beginning:** 1979 **End:**  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware Bay: (Same as Smith and Daiber)	0 - 72	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 30 ft otter trawl

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 2 in. mesh cod-end - 3 in. mesh body - 1 in. mesh cod-end in September for juveniles

**Other methodologies:** 20 minute tows against tide

**Quality control measures:**

**8. Data Processing:**

Compared relative size compositions of weakfish populations in Delaware Bay through comparison of length-frequency-mean length data for species from trawl periods 1953-1956, 1966-1971, and 1979. Determined density of weakfish in 1979 and compared with 66 ft - 71 ft survey. Monthly densities presented as total number of weakfish per month divided by total distance towed.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study examines the density of weakfish in the lower Delaware Bay in 1979 and compares this to previous density measurements. Data are also presented on CPUE of the recreational weakfish fisheries in Delaware Bay. (1968-1979). Mean density ranged from <0.1 in December to 10.4 in September. Relatively constant May (1.5), June (1.6), July (1.6), November (1.6).

**1. Cited Reference:**

Seagraves, R.J. and R.W. Cole. 1989. Monitoring Fish Populations in Delaware's Estuaries. 1989. Performance Report F-37-R-4.

**2. Principal Investigator:**

**Name:** Richard J. Seagraves

**Address:** Delaware Division of Fish and Wildlife  
Dover, Delaware

**Telephone:** (302)739-4782

**As of (date):** 1989

**3. Repository of data set or reference:**

Delaware Department of Natural Resources and Environmental Concerns

**4. General Data Type:**

**Parameters measured:** Fish-relative abundance, distribution, annual production.

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Attempt to estimate recruitment for prediction of future trends in adult stock size and harvest potential.

**Sample Dates:** **Beginning:** April 1988 **End:** October 1988

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 39 in Bay and River

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware Bay	10 to 127	Specific coordinates not given.
Delaware/Pennsylvania State Line to Prime Hook Beach		Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Sort catch by species, enumerate, measure up to 30 of selected species. Record hydrographic data and rpm of tow. 16 ft. otter trawl.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:** 10 minute tows

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Produce monthly summary of catch data including number of species taken, total number taken by species group and mean CPUE. Tabulate size-frequency of juvenile blue crabs and monthly estimates of number crabs/tow.

**9. Data Evaluation:**

**10. Companion Studies:**

Daiber and Smith (1971)  
Smith (1987)

**11. Comments:**

This study reports on the results of the 1989 trawl survey in Delaware. This study continues a study which was initiated in 1977 for juvenile blue crabs, and in 1980 expanded to include juvenile fish. The blue crab study attempts to assess annual production and the juvenile fish study determines relative abundance and distribution.

1. **Cited Reference:**  
Shuster, C.N., Jr. 1959. A biological evaluation of the Delaware River Estuary. Info. Ser. Publ. No. 3. 77 p. University of Delaware Marine Laboratory.
  
2. **Principal Investigator:**  
Name: Carl N. Shuster  
Address: University of Delaware Marine Laboratory  
Lewis, Delaware  
Telephone: (302)645-4000 As of (date): 1959
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Fish - abundance, distribution
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Highlight features about the Delaware Coastal waters from the marine biology viewpoint.  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Augustine Beach	85	Specific coordinates not given.
Woodland Beach	64	Same
Kitts Hummonk	40	Same
Slaughter Beach	13	Same
Lewes Beach	0	Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Used literature

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Presents data collected by Daiber (1954) at shore zone beaches along Delaware coast. Ranks relative abundance of these fish at each station. Evaluate importance of commercial and recreational fisheries in the estuary.

**9. Data Evaluation:**

**10. Companion Studies:**

Daiber (1954).

**11. Comments:**

This study provides historical data on the status of shore zone fishes in the lower Delaware estuary. It also assesses the economic impact of the commercial and recreational fisheries during this time.

1. **Cited Reference:**  
Slack, J.H. 1874. Notes on the shad as observed in the Delaware River. pp. 457-460. In: U.S. Commission of Fish and Fisheries. Report of the Commissioner. 1872-1873.
2. **Principal Investigator:**  
Name: J.H. Slack  
Address: U.S. Commission of Fish and Fisheries  
  
Telephone: \_\_\_\_\_ As of (date): 1984
3. **Repository of data set or reference:**  
U.S. Commission of Fish and Fisheries
4. **General Data Type:**  
Parameters measured: Fish - catch per unit effort
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Discuss the shad fishery in the Delaware River and examine trends in landings.  
Sample Dates: Beginning: 1872 End: 1873  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	--	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Observations and reported landings.

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Presents information on the shad fishery in the Delaware River.

Calculates and presents number of fish/net set for some years and attempts to examine reasons for decline.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study provides historical information on the shad fishery in the Delaware River. It provides data on numbers of fish landed and speculates on reasons for declines in landings.

1. **Cited Reference:**  
Smith, B.A. 1971. The fishes of four low-salinity tidal tributaries of the Delaware River estuary. Ichthyological Associates, Middletown, Delaware. 291 p.
  
2. **Principal Investigator:**  
Name: Barry A. Smith  
Address: Ichthyological Associates, Inc.  
Box 35, R.D. 2  
Middletown, DE 19709  
Telephone: \_\_\_\_\_ As of (date): 1971
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Fish - abundance, distribution
  
5. **Sample Matrices:**  
Water - fish communities
  
6. **Sampling Design:**  
Purpose of Study: Gather data on the fishes of four low-salinity tidal creeks in the Delaware estuary.  
Sample Dates: Beginning: May 1969 End: July 1970  
Sample Frequency: Variable  
Number of Sampling Stations: 34

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Blackbird Creek to the mouth of Alloway Creek	80 - 88	No specific coordinates given in publication.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 10 ft. minnow seine.  
9 ft semi-balloon trawl

**Number of Replicate Samples:** Replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** Seine - 1/8 in. mesh  
Trawl - 1/2 in. to 1-1/2 in. liner

**Other methodologies:** Trawls - 5 minutes at 2200 rpm with the tide

**Quality control measures:**

**8. Data Processing:**

Data presented by sampling date and station. Monthly summary of fishes collected presented.

**9. Data Evaluation:**

**10. Companion Studies:**

Shuster (1959)  
Daiber (1963)  
Scotton (1970)

**11. Comments:**

1. **Cited Reference:**  
Smith, R.W. 1980. Marine Fish Populations in Delaware Bay and shore zone. Delaware Division of Fish and Wildlife. Delaware Hall of Records No. 40-05/80/03/3. Dover, Delaware.
  
2. **Principal Investigator:**  
**Name:** R.W. Smith  
**Address:** Delaware Division of Fish and Wildlife  
Dover, Delaware  
**Telephone:** (302)739-3441 **As of (date):** 1980
  
3. **Repository of data set or reference:**  
Delaware Hall of Records; Delaware Documentation No. 40-05/80/03/3
  
4. **General Data Type:**  
**Parameters measured:** Fish-number fish/haul
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Fixed station. Identify species composition and abundance in the Delaware Bay and identify temporal, spatial and length-frequency distributions.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:** Monthly  
**Number of Sampling Stations:** 11

**Sample Locations:**

General Location	DRBC River km	Coordinates
Trawl Survey - Mouth of Delaware Bay to 39° 25ft lat. (44.97)	0-72	Upper boundary - 39° 25ft latitude
Four Areas with Seine:		
Augustine Beach	85	
Woodland Beach	64	
Pickering Beach	42	
Bowers Beach	37	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 30 ft otter trawl towed for 20 minutes, average speed 2.9 knots. Trawl - 8.5 m, 3 in. stretch mesh in body, 2 in. in cod-end, in September a 1 in. cod-end. Seine - 100 ft x 6 ft x 3/8 in. stretch mesh, 6 x 6 x 6 ft bag.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Loran used to determine tow length and speed. Excluded species like *Anchoa spp.* which could slip through net.

**8. Data Processing:**

Determined mean number of fish

**9. Data Evaluation:****10. Companion Studies:**

Daiber and Smith (1966-1971)

**11. Comments:**

This is the first in a series of trawl surveys which are currently being conducted by Delaware. Gives estimates on relative abundance. High variability forced the cessation of the seine study.

Results: Seine, Smith, 1979.

	July/Aug/Sept <u>Augustine Beach</u>	<u>Woodland Beach</u>	<u>Bowers Beach</u>	<u>Pickering Beach</u>
<i>A. Mitchilli</i>	266,301,162	1374,424,70	9,31,25	16,18,584
<i>M. Memidia</i>	11,14,25	292,119,62	29,298,248	416,448,170
<i>A. Rostrate</i>	1,0,0	---	3,0,0	1,0,4
<i>B. Tyrannous</i>	21,143,109	184,2,6	8,6,12	1766,418,2
<i>C. Regalis</i>	1,0,0	7,14,2	22,7,0	1,0,84,10
<i>L. xanthusus</i>	1,0,2	8,8,2	3,2,2	125,24,8
<i>F. majalis</i>	---	5,0,0	10,14,12	13,16,3
	<u>average #/haul</u>		Very high variability	

1. **Cited Reference:**  
Smith, R.W. 1987. Marine Fish Populations in Delaware Bay. Project No. F-34-R. Delaware Division of Fish and Wildlife, Dover, Delaware.
  
2. **Principal Investigator:**  
**Name:** Ronal W. Smith  
**Address:** Delaware Division of Fish and Wildlife  
Dover, Delaware  
**Telephone:** (302)739-4782 **As of (date):** 1987
  
3. **Repository of data set or reference:**  
Delaware Division of Fish and Wildlife, Dover, Delaware
  
4. **General Data Type:**  
**Parameters measured:** Fish - number of fish/.1 nm, distribution, catch composition
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** To examine fish populations in Delaware Bay to characterize their temporal, spacial and length-frequency distributions, and relate fish presence to various physical and chemical parameters.  
**Sample Dates:** Beginning: 1979 End: 1984  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Lower Delaware Estuary (see Daiber and Smith 1971)	0 - 72	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 8.5 m otter trawl. Trawl 76 mm body and 51 mm cod-end in September, and cod-end of 25 mm.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:** Towing speed 2.9 knots for 20 minutes

**Quality control measures:** Estimate distance trawled using LORAN.

**8. Data Processing:**

Compare number of species collected each year between the two studies (using ANOVA). Examined seasonal distribution of species abundance. Compare differences in catch per unit of effort between the two studies. Examine catch composition and spatial distribution of species collected.

**9. Data Evaluation:**

**10. Companion Studies:**

Smith 1980), Smith (1981), Daiber and Smith (1971) - Delaware-DNREC-continues similar survey (Seagraves, 1990).

**11. Comments:**

This study summarizes results from the 1979-1984 Delaware trawl survey and compares to results of 1966-1971 survey. This survey provides long-term data on species abundance, and distribution in the lower Delaware estuary. One problem mentioned is the extreme variability between samples in many instances.

1. **Cited Reference:**  
Smith, R.W. and F.C. Daiber. 1977. Biology of the summer flounder, *Paralichthys dentatus*, in Delaware Bay. Fish. Bull. 75(4):823-830.
  
2. **Principal Investigator:**  
Name: Ronal W. Smith  
Address: University of Delaware  
Lewes, Delaware  
Telephone: (302)645-4000 As of (date): 1977
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
Parameters measured: Fish - seasonal distribution
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
Purpose of Study: Investigate biology of the summer flounder in Delaware Bay.  
Sample Dates: Beginning: August 1966 End: November 1971  
Sample Frequency: Variable  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Delaware Bay to just south of Cohansey River	0 - 60	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** 30 ft otter trawl - 3 in. stretch mesh body, 2 in. stretch mesh cod-end.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

The primary objective of the paper is to process information on age and growth, gonad development, food preference and racial analysis of the summer flounder.

**9. Data Evaluation:**

**10. Companion Studies:**

Daiber and Smith (1971)

**11. Comments:**

This study reports some general observations on the summer flounder. Discusses distribution and corresponding temperature, salinity, and depth ranges were collected. Also reports annual relative abundance estimates, and seasonal distribution in the lower Delaware estuary. Distribution appeared ubiquitous.

**1. Cited Reference:**

Smith, T.I.J. 1985. The fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in North America. *Env. Biol. Fish.* 14:61-72.

**2. Principal Investigator:**

**Name:** Theodore I.J. Smith  
**Address:** South Carolina Wildlife and Marine Resources  
Department  
Charleston, South Carolina

**Telephone:** \_\_\_\_\_ **As of (date):** 1985

**3. Repository of data set or reference:**

Versar, Inc., Columbia, Maryland

**4. General Data Type:**

**Parameters measured:** Fish - kilograms landed

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Provide a summary of fisheries and biological data on this species and discusses management recommendations.

**Sample Dates:** **Beginning:** \_\_\_\_\_ **End:** \_\_\_\_\_

**Sample Frequency:** \_\_\_\_\_

**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
North America: Delaware estuary	0 - 217 +	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Literature search and summary.

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate sturgeon landing (by state) for the years 1888-1892 and 1978-1982. Discuss life history characteristics of Atlantic sturgeon.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study discusses the commercial fisheries of Atlantic sturgeon over time. Fluctuations in landings are discussed for the states in the Delaware estuary region.

1. **Cited Reference:**  
Summers, J.K. and K.A. Rose. 1987. The role of interactions among environmental conditions in controlling historical fisheries variability. *Estuaries*. 10:255-266.
  
2. **Principal Investigator:**  
**Name:** J. Kevin Summers  
**Address:** Versar, Inc.  
Columbia, Maryland  
**Telephone:** (301)964-9200 **As of (date):** 1987
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - stock abundance, hydrographic variability, anthropogenic factors.
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Detect relationships from biological and environmental data using categorical time-series regression.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217	Specific coordinates not given.
Hudson River		
Potomac River		

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

Number of Replicate Samples:  
Area of Volume per Replicates:  
Net, sieve, or filter size:  
Other methodologies:  
Quality control measures:

**8. Data Processing:**

Develop categorical time-series regression models for striped bass and American shad. Evaluated the influence of lagged stock abundance history, hydrographic variability and anthropogenic factors in controlling variability in abundance.

**9. Data Evaluation:**

**10. Companion Studies:  
Summers, et al. (1985)**

**11. Comments:**

This study compares factors which may influence the abundance of striped bass of shad. It appears that hydrographic factors dominate striped bass dynamics in the Delaware estuary, whereas shad are very dependent on anthropogenic versus hydrographic factors.

1. **Cited Reference:**  
 Sykes, J.E. and B.A. Lehman. 1957. Past and Present Delaware River Shad Fishery and Considerations for its Future. U.S. Fish and Wildlife Service, Research Report No. 46. Washington, D.C.
  
2. **Principal Investigator:**  
**Name:** James E. Sykes  
**Address:** U.S. Fish and Wildlife Service  
 Washington, D.C.  
**Telephone:** \_\_\_\_\_ **As of (date):** 1957
  
3. **Repository of data set or reference:**  
 College of Charleston
  
4. **General Data Type:**  
**Parameters measured:** Fish - distribution, abundance
  
5. **Sample Matrices:**  
 Water - fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide general historical and "current" data on shad stocks in the Delaware estuary.  
**Sample Dates:** Beginning: 1837 End: 1954  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217 +	Specific coordinates not given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

This paper reviews the history of the shad fishery in the Delaware Estuary and evaluates factors which have effected shad populations.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This paper provides valuable historical data on the shad fishery and distribution and migrations of shad. Also examines possible factors influencing the shad population.

1. **Cited Reference:**  
Taylor, M.H., R.W. Smith, L.M. Katz, F.C. Daiber, V. Lotrich. 1973. Appendix VII. - Delaware Fish Survey, final report. In: Hydrographic and ecological effects of enlargement of the Chesapeake and Delaware Canal. Department of Biology. University of Delaware, Newark, Delaware.
  
2. **Principal Investigator:**  
**Name:** Malcolm H. Taylor  
**Address:** Department of Biological Sciences  
University of Delaware, Newark, Delaware  
**Telephone:** (302)465-4000 **As of (date):** 1973
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - relative abundance, rank, distribution
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Survey fish populations in the C&D Canal and adjacent Delaware River.  
**Sample Dates:** **Beginning:** March 1971 **End:** August 1973  
**Sample Frequency:** 10 collections - monthly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
One other north end of dike		Specific coordinates not given.
Pea Patch Island	102	Same
C&D Canal	95	Same
Reedy Island	88	Same
Main C&D Canal	95	Same

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 3 in. mesh, 1 in. mesh liner

**Other methodologies:** Make 2 (.5 mile) trawls at each station towing at 3-4 mph relative to current. 30 ft otter trawl.

**Quality control measures:**

**8. Data Processing:**

Calculate length-weight relation for common species. Estimate monthly fish biomass at each station for six major species. Determined if correlations existed between numbers of fish and physical parameters. Tabulates fish/station/.1 mm for all stations.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study reports the relative abundance of species collected with trawls in the vicinity of the C&D Canal. It also estimates standing crop (by month and station) for six common species.

**1. Cited Reference:**

Thomas, D.L. 1971. The early life history and ecology of six species of drum (Sciaenidae) in the lower Delaware River, a brackish tidal estuary. In: An Ecological Study of the Delaware River in the Vicinity of Artificial Island. Progress Report for the period January-December 1970. Part III. Ichthyological Associates, Inc., Middletown, Delaware.

**2. Principal Investigator:**

**Name:** David L. Thomas  
**Address:** Ichthyological Associates, Inc.  
Middletown, Delaware

**Telephone:** \_\_\_\_\_ **As of (date):** 1971

**3. Repository of data set or reference:**

Ichthyological Associates, Inc., Middletown, DE

**4. General Data Type:**

**Parameters measured:** Fish - distribution, abundance, CPUE

**5. Sample Matrices:**

Water-fish communities

**6. Sampling Design:**

**Purpose of Study:** Examine various life history and ecological aspects of *sciaenids* in the Delaware River.

**Sample Dates:** Beginning: June 1968 End: December 1970

**Sample Frequency:** Monthly

**Number of Sampling Stations:** 21 trawl zones/8 seine

**Sample Locations:**

General Location	DRBC River km	Coordinates
Salem Nuclear Generating Station (10 miles north and south of station)	79-92	Specific coordinates not given.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Trawl - 16 ft semiballoon otter trawl. 25 ft. trawl - (25 ft or 75 ft) x 5 ft x 1/4 in. or -220 ft Bay seine.

**Number of Replicate Samples:** Existence of replicate samples not mentioned.

**Area of Volume per Replicates:**

**Net, sieve, or filter size:** 1-1/2 in. body, 1/2 in. cod-end liner.

**Other methodologies:** Trawl for 10 minutes at approximately 4 mph.

**Quality control measures:**

**8. Data Processing:**

Determined age and growth parameters, length-weight relationships, and food habits of collected sciaenids. Raw data presented in other IA reports (see companion studies). Compile data on spawning, distribution and abundance of adult sciaenids. Report average number per haul-on east and west side of river and total.

**9. Data Evaluation:**

**10. Companion Studies:**

Raney, et al. (1969)  
Schuler, et al. (1970)  
Schuler (1970)

**11. Comments:**

1. **Cited Reference:**  
Versar, Inc. 1990. Fisheries Management Report No. 16 of the Atlantic States Marine Fisheries Commission, Source Document for the supplement to the striped bass FMP - Amendment No. 4. Columbia, Maryland.
  
2. **Principal Investigator:**  
**Name:** Versar, Inc.  
**Address:** Columbia, Maryland  
  
**Telephone:** (301) 964-9200 **As of (date):** 1990
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - catch per unit effort
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Summarize data and information used in developing the management regimes specified in Amendment 4.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Atlantic Coast		

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

Number of Replicate Samples:

Area of Volume per Replicates:

Net, sieve, or filter size:

Other methodologies:

Quality control measures:

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This report provides fisheries information on the status of the Atlantic Coast stocks of striped bass. Some of the data presented in this report is specific to the Delaware estuary, including examination of status of striped bass, and a presentation of CPUE of the seasonal sportfishery for striped bass in the Delaware River (1985-1989).

1. **Cited Reference:**  
Walburg, C.H. and P.R. Nichols. 1967. Biology and management of the American shad and status of the fisheries, Atlantic Coast of the United States, 1960. U.S. Fish and Wildlife Service, Spec. Sci. Rep. Fish. 550., 105 pp.
2. **Principal Investigator:**  
Name: Charles H. Walburg  
Address: Bureau of Commercial Fisheries Biological Laboratory  
Beaufort, North Carolina  
Telephone: \_\_\_\_\_ As of (date): 1967
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
4. **General Data Type:**  
Parameters measured: Fish - pounds landed
5. **Sample Matrices:**  
Water-fish communities
6. **Sampling Design:**  
Purpose of Study: Summarize current information on the American shad and describes the species and the fishery.  
Sample Dates: Beginning: \_\_\_\_\_ End: \_\_\_\_\_  
Sample Frequency: \_\_\_\_\_  
Number of Sampling Stations: \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217+	Specific coordinates not given.
Atlantic Coast	--	

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:** Used literature

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

This paper provides background information on the American shad including general distribution, life history, causes of mortality. Uses commercial landings statistics to examine historical and current catch of shad.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This paper provides an historical evaluation of the American shad fisheries. It also examines factors affecting the decline in abundance including physical changes, dams, pollution overfishing and natural cycles. Specifics on the shad fishery in New Jersey, Pennsylvania and Delaware are provided.

1. **Cited Reference:**  
Williams, J.E., J.E. Johnson, D.A. Hendrickson, S. Contreras-Balderas, J.D. Williams, M. Navarro-Mendoza, D.E. McAllister, and J.E. Deacon. 1989. Fishes of North America Endangered, Threatened, or of Special Concern: 1989. Fisheries, 14:2-20.
  
2. **Principal Investigator:**  
**Name:** J.E. Williams  
**Address:** Division of Wildlife and Fisheries  
Washington, D.C.  
**Telephone:** \_\_\_\_\_ **As of (date):** \_\_\_\_\_
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, Maryland
  
4. **General Data Type:**  
**Parameters measured:** Fish - status
  
5. **Sample Matrices:**  
Water-fish communities
  
6. **Sampling Design:**  
**Purpose of Study:** Document North America's endangered, threatened, and species of special concern.  
**Sample Dates:** **Beginning:** \_\_\_\_\_ **End:** \_\_\_\_\_  
**Sample Frequency:** \_\_\_\_\_  
**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
North America	--	

**7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**  
**Area of Volume per Replicates:**  
**Net, sieve, or filter size:**  
**Other methodologies:**  
**Quality control measures:**

**8. Data Processing:**  
Tabulate species and their status in North America.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**  
The only endangered species in the Delaware estuary is the shortnose sturgeon. Atlantic sturgeon are listed as species of special concern.

**BIRDS**

**1. Cited Reference:**

Alexander, H.L., Jr. 1981. Delaware's endangered species program. Project E-1-2. January 1980-December 1981. Delaware Division Fish and Wildlife, Dover, Delaware.

**2. Principal Investigator:**

**Name:** H.L. Alexander

**Address:** Delaware Division Fish and Wildlife  
Dover, DE

**Telephone:** (302)739-5297

**As of (date):**

**3. Repository of data set or reference:**

Delaware Hall of Records, Dover, DE

**4. General Data Type:**

**Parameters measured:** Birds - endangered species, counts, #  
young

**5. Sample Matrices:**

Air - bird communities

**6. Sampling Design:**

**Purpose of Study:** Monitor populations of endangered species in Delaware River

**Sample Dates:** **Beginning:** January 1980 **End:** December 1981

**Sample Frequency:**

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware State	0 - 127	Specific locations given in figure in text.

- 7. Sampling Methodologies:**  
Sample Gear, Methods and Analyses: Survey  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Monitor location of bald eagle nest sites, report if nest active and count number fledged.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Alexander (1979, 1980)  
Gelvin-Innvaer (1978-1990)
- 11. Comments:**  
This study provides an annual inventory of bald eagle nesting sites and nesting success in the State of Delaware. Lisa Gelvin-Innvaer provided a table of the 1978-1990 data.

1. **Cited Reference:**  
Almshouse Neshaminy Manor Center. 1990. Species of special concern in Bucks County. Summer Newsletter Doylestown, PA.
  
2. **Principal Investigator:**  
**Name:** Almshouse Neshaminy Manor Center.  
**Address:** Doylestown, PA 18901  
  
**Telephone:** (215)345-3400 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - status in Pennsylvania and Bucks County
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Examine changes in bird populations  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Bucks County, PA	180 to 283	No specific coordinates given in publication.

- 7. Sampling Methodologies:**  
Incorporate data from Bucks County Audubon Society and Pennsylvania Breeding Bird Atlas Project  
**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**
- 8. Data Processing:**  
Produced newsletter delineating status of particular bird species in Bucks County. Utilized historical data from Audubon Society and recent data accumulated during Pennsylvania Breeding Bird Atlas project.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**  
Designates species as threatened, special concern, rare breeder or extirpated in Bucks County also gives Pennsylvania status (developed by Pennsylvania Game Commission).

1. **Cited Reference:**  
Audubon Christmas Bird Count. 1961-1988. Obtained on diskette from Cornell Laboratory of Ornithology.
  
2. **Principal Investigator:**  
**Name:** Gregory S. Butcher/Jim Lowe  
**Address:** Cornell Laboratory of Ornithology  
Ithaca, NY 14850  
**Telephone:** (607)254-2412 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Cornell Ornithology Lab
  
4. **General Data Type:**  
**Parameters measured:** Birds - direct counts of birds within count circle
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Survey wintering bird populations within each count circle.  
**Sample Dates:** **Beginning:** December 1966 **End:** December 1988  
**Sample Frequency:** Annual count  
**Number of Sampling Stations:**

Audubon Christmas Bird Count 1961-1988 (cont.)

Sample Locations: Throughout Delaware Estuary

General Location	DRBC River km	Coordinates	
<u>Delaware</u>			
Bombay Hook		39°13'N	75°27'W
Cape Henlopen/Prime Hook		38°48'	75°11'
Middletown		39°28'	75°38'
Wilmington		39°44'	75°38'
Wilmington		39°45'	75°37'
<u>Pennsylvania</u>			
Glenolden		39°54'	75°22'
Lower Bucks County		40°11'	74°54'
Penney Pack Valley		40°04'	75°02'
Penney Pack Valley		40°08'	75°04'
Wyncote		40°05'	75°08'
Wyncote		40°05'	75°10'
<u>New Jersey</u>			
Northwestern Gloucester		39°46'	75°14'
Co.		39°15'	74°36'
Beuplain		39°01'	74°52'
Cape May		39°20'	75°12'
Cumberland Co.		39°57'	74°56'
Moorestown-Mapleshade-			
Riverton		39°58'	74°44'
Mount Holly		39°37'	75°25'
Salem		40°11'	74°43'
Trenton marshes			

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:** Count circle 7.5 mi radius

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Cornell Ornithology Lab has computerized the data which was originally published in *Audubon Field Notes* and *American Bird*.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provides long-term database which should be useful in examining status and trends of species found within the Delaware estuary.

1. **Cited Reference:**  
Brauning, D. In Press. Pennsylvania Breeding Bird Atlas Project.
2. **Principal Investigator:**  
**Name:** Dan Brauning  
**Address:** Pennsylvania Game Commission  
Harrisburg, PA  
**Telephone:** (717)547-6938 **As of (date):**  
12/90
3. **Repository of data set or reference:**  
Pennsylvania Game Commission, Harrisburg, PA
4. **General Data Type:**  
**Parameters measured:** Birds - breeding, possible, probable and confirmed breeding of species
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
**Purpose of Study:** Identify and plot the location of the species of birds that breed in the state.  
**Sample Dates:** **Beginning:** Spring 1984 **End:** Fall 1988  
**Sample Frequency:** Variable  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Bucks County	180-283	No specific coordinates given in publication.
Philadelphia County	146-180	Same
Delaware County	126-146	Same

**7. Sampling Methodologies:**

Ground surveys of each block. Examine block to determine breeding species. Give code for possible, probable and confirmed breeding (codes are further subdivided)

**Sample Gear, Methods and Analyses:** Binoculars

**Number of Replicate Samples:**

**Area of Volume per Replicates:** Block - 1/6th of U.S.G.S.  
topographic map

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

For each county, there is a listing of species reported, with the number of blocks in which it was reported and the highest breeding code that was observed in that block. Data still being processed for publication.

**9. Data Evaluation:**

**10. Companion Studies:**

Delaware Breeding Bird Atlas (West et al. In Press) and NJ Breeding Bird Atlas (Hughes In Press)

**11. Comments:**

For each of the three counties located along the Delaware estuary, there is a summary of the breeding status of important species. However, at this time it was not possible to receive the data on a spatial basis (by block) within each county. When published (1991), data should be available on a spatial basis within each county. For example, further subdividing each county by block would give a more thorough representation of species distribution in the Delaware estuary.

1. **Cited Reference:**  
Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. Environ. Conserv. 13:123-130.
  
2. **Principal Investigator:**  
Name: Joanna Burger  
Address: Department of Biological Sciences  
Rutgers University, New Jersey  
Telephone: (908)932-4318 As of (date): 12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Birds - shorebirds, numbers, response to disturbance
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Census shorebirds and assess effects of human activities.  
Sample Dates: Beginning: April 20, 1982 End: Oct. 26, 1982  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Norburgs Landing	18	No specific coordinates given in publication.
Reeds Beach North	24	Same
Reeds Beach South	24	Same
Moore's Beach	29	Same

**7. Sampling Methodologies:**

Aerial and ground surveys

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Uses multiple regressions to examine effects of independent variables on the behavior of shorebirds

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Determined species composition of shorebirds in Delaware and Raritan Bay. Eight of 27 species accounted for 95.4% of shorebirds

1. Semi-palmated sandpipers
2. Ruddy turnstone
3. Sanderling
4. Dovitchers (2577)
5. Red knot
6. Dunlin
7. Greater yellowlegs

**1. Cited Reference:**

Burger, J. 1989. Least tern populations in coastal New Jersey: Monitoring and management of regionally-endangered species. Jour. Coastal Research. 5:801-811.

**2. Principal Investigator:**

**Name:** Joanna Burger

**Address:** Department of Biological Sciences  
Rutgers University

**Telephone:** (908)932-4318

**As of (date):** 12/90

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Birds, population estimates,  
reproductive success

**5. Sample Matrices:**

Air - bird communities

**6. Sampling Design:**

**Purpose of Study:** Monitor population of least tern colonies in coastal New Jersey and evaluate methods of protecting and managing colonies.

**Sample Dates:** **Beginning:** 1976 **End:** 1985

**Sample Frequency:** summers

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape May	0	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Aerial surveys, ground surveys

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Training program for census personnel

**8. Data Processing:**

Examined trends in least tern abundance and production overtime.  
Examined causes of colony failures. Evaluated success of  
different protection methods.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Although this paper deals with monitoring managing and  
protecting least terns, many factors that have caused the  
population decline are identified. These factors may be  
responsible for population changes in many species which inhabit  
the coastline.

1. **Cited Reference:**  
Burger, J. and J. Galli. 1987. Factors affecting distribution of Gulls (*Larus* spp.) on two New Jersey Coastal Bays. Environ. Conserv. 14:59-65.
  
2. **Principal Investigator:**  
Name: Joanna Burger  
Address: Department of Biological Sciences  
Rutgers University, NJ  
Telephone: (908)932-4318 As of (date): 12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Birds - gulls, direct counts
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Examine distribution and species composition of gulls near Delaware and Raritan Bay relative to effects of environmental variables and human disturbance.  
Sample Dates: Beginning: Apr 20, 1982 End: Oct. 26, 1982  
Sample Frequency: Once a week - Apr, May, Jun aerial survey; weekly ground surveys Apr-Oct  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Mouth of Bay	0	No specific coordinates given in publication.
Delaware Memorial Bridge	110	Same

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Determined relative importance of gulls (expressed as number, and % of total) and shorebirds in Delaware and Raritan Bay. Tabulated species composition from each bay area. Determined a spatial distribution of gulls on Delaware Bay. Examines response of gulls to various factors.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This manuscript describes the importance of gulls in the Delaware estuary by examining their relative proportion with other shorebirds. It also gives a thorough examination of species composition and spatial distribution throughout the Delaware estuary.

**1. Cited Reference:**

Clark, K.E. 1989a. 1988 Delaware Bay shorebird project: Final Report. New Jersey Department of Environmental Protection, Division Fish, Game and Wildlife. Trenton, NJ.

**2. Principal Investigator:**

**Name:** Kathleen E. Clark  
**Address:** Endangered and Nongame Species Program  
NJ Department of Environmental Protection  
Division Fish Game and Wildlife  
**Telephone:** (609)628-2103 **As of (date):**  
12/90

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Birds - shorebirds, number of birds, by species

**5. Sample Matrices:**

Air - bird communities

**6. Sampling Design:**

**Purpose of Study:** Determine shorebird abundance, distribution along bayshore habitat and population trends of the 4 major species.

**Sample Dates:** Beginning: 6 May End: 9 June

**Sample Frequency:** weekly

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Flights from Cape May Canal to Cohansey Point on New Jersey side and Woodland Beach south to Cape Henlopen on Delaware side	0 to 61	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate shorebirds counted on Delaware Bay, Spring 1988, for the most commonly observed species. Examines distribution by location along transect on New Jersey and Delaware sides of Delaware Bay.

**9. Data Evaluation:**

**10. Companion Studies:**

K. Clark (1988, 1987) Similar surveys to this. K. Clark and L. Niles (1986) examine use of 3 Delaware Bay beaches by migrating shorebirds in New Jersey.

**11. Comments:**

This study provides quantitative information on abundance of migratory shorebirds in the Delaware Bay region in May-June, 1988. It also reports previous data on shorebirds from studies in 1982-83, 1986-88. Examines trends in abundance. Also distribution of peak numbers of shorebirds along both bayshores are documented. Four species accounted for 99% of all birds counted: semipalmated (62%) sandpiper, ruddy turnstone (23%), red knot (10%), and sanderling (3.5%), Dunlin dowitcher another 1%. Summary table provides comparison of counts from 1986-1988. Study also includes a human-use survey of people involved with specific activities along the beaches.

1. **Cited Reference:**  
Clark, K.E. 1989b. 1988 osprey management in New Jersey. New Jersey Department of Environmental Protection, Division of Fish, Game, and Wildlife, Trenton, NJ.
  
2. **Principal Investigator:**  
**Name:** Kathleen Clark  
**Address:** Endangered and Nongame Species Program  
New Jersey Department of Environmental Protection  
Division of Fish, Game, and Wildlife  
Trenton, NJ  
**Telephone:** (609)628-2103 **As of (date):** 12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - osprey, number occupied nests, number of chicks
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Identify osprey nesting areas and productivity of nests.  
**Sample Dates:** **Beginning:** Mid-June **End:** Mid-June  
**Sample Frequency:** 1 survey  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
<u>Delaware Estuary</u> Burlington County Camden County Cape May County Cumberland County Monmouth County Salem County	0 - 217	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Aerial survey

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Tabulate numbers of osprey in occupied nests, number of chicks, etc. for eight New Jersey counties. Examine changes in numbers of occupied nests from 1982-1988 in those counties. Production is determined to be the number of chicks per known nest.

**9. Data Evaluation:**

**10. Companion Studies:**

(1) Frier (1981), (2) Frier-Murza and Kell (1984), (3) Niles et al. (1984).

**11. Comments:**

This study provides quantitative information annually on the relative distribution and abundance of osprey nests in New Jersey from 1982-1988.

1. **Cited Reference:**  
Clark, K.E. 1990. Research and Management of the Perigrine Falcon. Project No. E-1-13. Department of Environmental Protection, Division Fish, Game and Wildlife, Trenton, NJ.
  
2. **Principal Investigator:**  
**Name:** Kathleen E. Clark  
**Address:** New Jersey Department of Environmental Protection  
Division Fish, Game and Wildlife  
CN 400  
Trenton, NJ  
**Telephone:** (609)628-2103  
**As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - Perigrine falcon, number of active breeding pairs, number of young fledged.
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** To maintain, monitor, and protect Perigrine falcon nest sites active in New Jersey.  
**Sample Dates:** **Beginning:** Mid to late **End:** Sept. 1990  
March, 1990  
**Sample Frequency:** weekly  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Commodore Barry Br.	132	No specific coordinates given in publication.
Betsey Ross Br.	169	Same
Walt Whitman Br.	156	Same
Ben Franklin Br.	161	Same
Delaware Water Gap (those listed include those sites found within the Delaware Estuary)	--	Same

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

Number of Replicate Samples:

Area of Volume per Replicates:

Net, sieve, or filter size:

Other methodologies:

Quality control measures:

**8. Data Processing:**

Report weekly observations on status of nest. This study documents annual production of each nest and preserves eggs or shells for pesticide and eggshell thinning analysis.

**9. Data Evaluation:**

**10. Companion Studies:**

Clark (1989), similar study which tabulates available data to 1989.

**11. Comments:**

Perigrine falcon production has been monitored since 1975. Those which nest on specific bridges in New Jersey are examined from 1982-1990. These bridge sites include nesting pairs located within the Delaware Estuary. Ten pairs of Perigrines in New Jersey were active in 1989. Seven on towers and buildings, three on bridges. Clark reports that results of contaminant analysis of eggs collected 1985-1988 revealed higher levels of DDE than previously collected eggs.

1. **Cited Reference:**  
Custer, T.W. and R.G. Osborn. 1977. Wading birds as biological indicators: 1975 Colony Survey. U.S. Fish and Wildlife Serv. Spec. Sci. Rep., Wildlife No. 206.
2. **Principal Investigator:**  
Name: Thomas Custer  
Address: USFWS  
Patuxent Wildlife Resource Center  
Laurel, MD  
Telephone: (301)776-4880 As of (date): 1977
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Birds - wading bird colonies, number adults, number nests, nesting stage, nest location
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
Purpose of Study: Examine the suitability of wading birds (herons and their allies) as biological indicators in the coastal environment.  
Sample Dates: Beginning: April, 1975 End: September 1975  
Sample Frequency: Surveyed areas 2 or more times  
Number of Sampling Stations:

Sample Locations: Florida to Maine

General Location	DRBC River km	Coordinates
In Delaware: Pea Patch Island	99	39°35'30"/75°34'00" 39°30'00"/75°36'30"

- 7. Sampling Methodologies:**  
Aerial searches, ground searches, contacting people familiar with area, etc.
- Sample Gear, Methods and Analyses:**
- Number of Replicate Samples:**
- Area of Volume per Replicates:**
- Net, sieve, or filter size:**
- Other methodologies:**
- Quality control measures:** Rechecked their survey areas at least two times.
- 8. Data Processing:**  
Recorded census information and located site on map. They present the maximum breeding population estimate for each species within the colony. Examined changes in species composition with latitudinal changes.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments**  
All of the colonies identified in New Jersey are located on the Atlantic Coast rather than on the Delaware Bay. A second portion of their study involved reproduction success of wading birds, however, none of these colonies were located within the Delaware Estuary. Found that wading bird abundance grossly correlated with coastal wetland abundance, by state.
- This study identified colonies of wading birds along the Atlantic Coast. Specific coordinates of colonies located in the Delaware Estuary are available. In each colony, number of species and total number of adults were determined. Also, numbers of individuals of each species were estimated or directly counted.

1. **Cited Reference:**  
Dunne, P. 1984. 1983 Northern Harrier breeding survey in coastal New Jersey. New Jersey Audubon Society. 10:3-5.
2. **Principal Investigator:**  
Name: Peter Dunne  
Address: Natural History Information Series  
New Jersey Audubon Society  
Telephone: (201)766-5787 As of (date): 12/90
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Birds - Northern Harrier, number nesting attempts, nest site habitat, nesting success
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
Purpose of Study: Identify the number of northern harrier nests in coastal New Jersey.  
Sample Dates: Beginning: March 1983 End: July 1983  
Sample Frequency: 29 days, 6 hrs/day  
Number of Sampling Stations:

Sample Locations: Delaware Bay and Atlantic Coast

General Location	DRBC River km	Coordinates
Cape May County to Mad Horse Creek	0 - 72.4	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Foot or car survey

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

The number and locations of confirmed breeding attempts. A comparison between 1983 and 1979 data. An assessment of breeding success and discussion of nest site habitat/substrate.

**9. Data Evaluation:**

**10. Companion Studies:**

Dunne (1986)

**11. Comments:**

The author believes that the apparent increase in number of nests is accurate and reflects a greater than 2x increase in the 4 year period. Mentions three breeding strongholds: 1) Turkey Point/Fortesque; 2) Dennis Creek; 3) Tuckahoe/Corgin. Provides good quantitative data on confirmed nesting attempts by the northern harrier in the coastal New Jersey marshes of Delaware Bay during 1983 and compares to 1979 survey results.

1. **Cited Reference:**  
Dunne, P. 1986. 1986 Northern Harrier Survey of New Jersey's Coastal Marshes.
  
2. **Principal Investigator:**  
**Name:** Peter Dunne  
**Address:** Natural History Information Series  
New Jersey Audubon Society  
**Telephone:** (201)766-5787 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - Northern Harrier, number of nests
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Investigate status of the states breeding harries.  
**Sample Dates:** **Beginning:** April, 1986 **End:** Aug., 1986  
**Sample Frequency:** Approximately 20 days  
**Number of Sampling Stations:** 18 on Delaware Bay

**Sample Locations:**

General Location	DRBC River km	Coordinates
Reeds Beach to Mad Horse Creek	24 - 66	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Ground survey to identify nesting pairs

**Sample Gear, Methods and Analyses:** Binoculars, plot locations on USGS topographic maps.

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Observe nesting attempts by the northern harrier, tabulate results of individual sightings, mating pairs and nests by station. Also, compare number of nests per site for 1979, 1983 and 1986.

**9. Data Evaluation:**

**10. Companion Studies:**

Dunne, 1984

**11. Comments:**

This study reports quantitative data on nesting of this species in the Delaware Bay region. The author reports that large variations in nest counts may be due influences of environmental conditions, such as high tides destroying nests, rather than population fluctuations.

1. **Cited Reference:**  
Dunne, P. and C. Sutton. 1986. Population trends in coastal raptor migrants over ten years of Cape May Point Autumn Counts. New Jersey Audubon Society. 12:39-43.
2. **Principal Investigator:**  
Name: Peter Dunne  
Address: Cape May Bird Observatory  
Cape May, NJ  
Telephone: (609)884-2736 As of (date): 12/90
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Birds - raptors, number of birds, by species
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
Purpose of Study: Record the number of migratory raptors.  
Sample Dates: Beginning: Sept. 1976 End: Dec. 1985  
Sample Frequency: daily for 71-111 days each year  
Number of Sampling Stations: 1

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape May Point	0	No specific coordinates given in publication.

- 7. Sampling Methodologies:**

Survey conducted from single fixed location

**Sample Gear, Methods and Analyses:** Binoculars

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**
- 8. Data Processing:**

Grouped species into categories of increasing, decreasing or stable over the ten year study period. Tabulate official count of number of birds of each species observed.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**

Has historic data from 1930's, for northern harrier, osprey, peregrine falcon, bald eagle, etc. Provide quantitative data on numbers of migratory raptors counted at Cape May during 1976-1985. Also provides information on effort (number of days and number of hours) each year. By identifying species as increasing, decreasing or stable, we may be able to relate this to trends in populations we see which breed or overwinter in Delaware Estuary.

1. **Cited Reference:**  
Dunne, P., R. Kare and P. Kerlinger. 1989. New Jersey at the crossroads of migration. New Jersey Audubon Society. Bernardsville, NJ
2. **Principal Investigator:**  
Name: Peter Dunne  
Address: New Jersey Audubon Society  
Telephone: (201)766-5787  
As of (date): 12/90
3. **Repository of data set or reference:**  
Rutgers University Library, New Brunswick, NJ
4. **General Data Type:**  
Parameters measured: Birds - migratory
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
Purpose of Study:  
Sample Dates: Beginning: End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of New Jersey	0-135	No specific coordinates given in publication.
Delaware Estuary	0-217	Same

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This book is a general reference of birds of New Jersey. Provides a time table of migratory birds and also includes specific information on some species. Appendix lists the birds of New Jersey in 3 categories: breeding, migrant, winter and identifies whether species is common, uncommon, rare, or former breeder in each category. Also lists preferred habitats for each species.

**1. Cited Reference:**

Dunne, P., D. Sibley, C. Sutton, and W. Warner. 1982. Aerial shorebird survey of Delaware Bay. New Jersey Audubon. Records of New Jersey Birds. 8:68-75.

**2. Principal Investigator:**

**Name:** Peter Dunne  
**Address:** Cape May Bird Observatory  
 Box 3  
 Cape May Point, NJ  
**Telephone:** (609)884-2736

**As of (date):**  
 12/90

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Birds - shorebirds, number of birds, by species

**5. Sample Matrices:**

Air - bird communities

**6. Sampling Design:**

**Purpose of Study:** Survey species composition and abundance of shorebirds along the Delaware Bay.

**Sample Dates:** Beginning: May, 1982 End: June, 1982

**Sample Frequency:** 3 flights

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape May Point	0	No specific coordinates given in publication.
Salem Nuclear Plant	87	Same

**7. Sampling Methodologies:**

Aerial surveys. Enumerated birds in blocks of 100 or 1000 and broke non-homogenous flocks into percent composition by species

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Totaled number of shorebirds and determined principal species.  
Examined spatial relationships of principal species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This quantitative survey in the lower portion of Delaware Estuary examines principal migratory shorebirds and examines their spatial distribution. Also, for dominant species suggests reasons for spatial distributions relating to feeding behavior and competition with other species.

1. **Cited Reference:**  
Erwin, R.M. 1979. Coastal waterbird colonies: Cape Elizabeth, Maine to Virginia. U.S. Fish and Wildlife Service, Biol. Serv. Prog., FWS/OBS-79/10. 212 p.
  
2. **Principal Investigator:**  
 Name: R.M. Erwin  
 Address: USFWS  
 Patuxent Wildlife Research Center  
 Laurel, MD  
 Telephone: (301)776-4880 As of (date):  
12/90
  
3. **Repository of data set or reference:**  
University of Maryland Library, College Park, MD
  
4. **General Data Type:**  
 Parameters measured: Birds - coastal waterbirds, number of colonies, identify species and their abundance, distribution of colonies
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
 Purpose of Study: Examine population trends of colonial birds from 1900-1977.  
 Sample Dates: Beginning: End:  
 Sample Frequency:  
 Number of Sampling Stations:

**Sample Locations:** Cape Elizabeth, Maine to Virginia

General Location	DRBC River km	Coordinates
Cape Henlopen State Park	0	No specific coordinates given in publication.
Milton	8	Same
Delaware City	97	Same
Pea Patch Island	98	Same

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:**  
  
Number of Replicate Samples:  
  
Area of Volume per Replicates:  
  
Net, sieve, or filter size:  
  
Other methodologies:  
  
Quality control measures:
- 8. Data Processing:**  
Examined historical data and provided data on coastal waterbird colonies and tabulated this information to examine population trends from 1900-1977.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Erwin and Korschgen (1979)
- 11. Comments:**  
Provides thorough examination of available data on colonial waterbird populations in the Delaware Estuary.

1. **Cited Reference:**  
Erwin, R.M. and C.E. Korschgen. 1979. Coastal Waterbird Colonies - Maine to Virginia. An atlas showing colony locations and species composition. U.S. Fish and Wildlife Service, Biol. Serv. Prog. FWS/OBS-79/08. 212 p.
  
2. **Principal Investigator:**  
**Name:** R.M. Erwin  
**Address:** USFWS  
Patuxent Wildlife Research Center  
**Telephone:** (301)776-4880 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - coastal waterbirds, number and location of colonies. Identify species composition and abundance.
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Atlas data for information reported in Erwin (1979). Plot location of colonies.  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape Henlopen State Park	0	No specific coordinates given in publication.
Milton	8	Same.
Delaware City	97	Same.
Pea Patch Island	98	Same.

**7. Sampling Methodologies:**

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Displayed data in atlas format

**9. Data Evaluation:**

**10. Companion Studies:**

Erwin (1979)

**11. Comments:**

This data useful in documenting actual locations of coastal waterbird colonies in the Delaware Estuary. Spatially represent location of colonial waterbird nests in the Delaware Estuary and enumerate number of nesting pairs.

1. **Cited Reference:**  
 Ferrigno, F. 1990a. New Jersey breeding population index. May 1989-May 1990. Project No. W-58-R-13. New Jersey Department of Fish, Game and Wildlife.
  
2. **Principal Investigator:**  
**Name:** F. Ferrigno  
**Address:** New Jersey Fish, Game and Wildlife  
 Trenton, NJ  
**Telephone:** (609)292-9450 (Tuckahoe office-(609)628-3218)  
**As of (date):** 12/90
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - breeding, direct counts of breeding birds
  
5. **Sample Matrices:**  
 Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Develop breeding population indices for important waterfowl species in the Atlantic flyway.  
**Sample Dates:** Beginning: April and May End: 1989, 1990  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Reeds Beach Road, Goshen Cr. to Stow Neck Road - Handocks Br.	26 to 88	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Randomly selected helicopter transects in salt marsh and randomly chosen square kilometer plots.

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:** Transect width 200 m. Count all birds.

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Have developed standardized methods which will allow comparison of data between states from Virginia-Maine.

**8. Data Processing:**

For upland areas - took counts by strata and projected totals for New Jersey for black duck, mallard, wood duck, canada goose and mute swan in 1989-1990. Examined percent change between years. For salt marshes, took counts from aerial surveys and projected total for New Jersey's salt marshes. Examined percent change for 1989-1990. For similar species.

**9. Data Evaluation:**

**10. Companion Studies:**

Ferrigno 1958-1966  
Ferrigno 1987-1989  
Ferrigno 1990

**11. Comments:**

This report provides quantitative estimates of waterfowl which New Jersey's upland areas and coastal salt marshes. Results of population estimates are divided into Atlantic Coast and Delaware Bay components for salt marsh areas. Results of study indicate the importance of Delaware Bay as black duck producing areas. Other species for which quantitative estimates are reported include: wood duck, mallard, gadwall, canada goose and mute swan.

1. **Cited Reference:**  
 Ferrigno, F. 1990b. New Jersey aerial surveys. November 1989-  
 April 1990. Proj. No. W-58-R-13. New Jersey Department of  
 Fish, Game, and Wildlife.
  
2. **Principal Investigator:**  
**Name:** F. Ferrigno  
**Address:** New Jersey Division Fish, Game, and Wildlife  
 Trenton/Tuckahoe, NJ  
**Telephone:** (609)628-3218 **As of (date):**  
 12/90
  
3. **Repository of data set or reference:**  
 Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - overwintering, direct counts
  
5. **Sample Matrices:**  
 Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** To determine annual population trends,  
 movements, distribution and location of  
 waterfowl in New Jersey.  
**Sample Dates:** **Beginning:** Fall-winter 1989-1990 **End:**  
  
**Sample Frequency:**  
**Number of Sampling Stations:**  
  
**Sample Locations:**

General Location	DRBC River km	Coordinates
West Creek - Riggins Ditch	29	No specific coordinates given in publication.
Rancocas Creek	179	Same.
Crosswicks Creek - Trenton Falls	206-217	Same.

**7. Sampling Methodologies:**

Aerial surveys, divide New Jersey into 5 major zones.

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Report 10 yr. surveys for state-wide survey (1981-1990) and examine percent change from 10 yr. average. Tabulate number of birds counted in each zone in 1989.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Aerial waterfowl surveys have been conducted along the coast of New Jersey for over 40 years (Ferrigno 1990). Examines black duck and canvasback in greater detail than some species.

This paper presents the status of waterfowl by zone in New Jersey during 1989, and also presents statewide information for 1981-1990. Statewide information valuable for detecting trends in populations of species. Data collected prior to 1989 is available, although stored mainly in files.

1. **Cited Reference:**  
Galli, J. and R. Kane. 1981. 1979 colonial waterbird populations of New Jersey. Occ. Pap. No. 139. New Jersey Audubon, Records of New Jersey Birds. 7:36-43.
  
2. **Principal Investigator:**  
Name: Joan Galli  
Address: New Jersey Audubon Society  
  
Telephone: (201)766-5787 As of (date):
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Birds - colonial waterbirds, number colonies, number active nests, number adults
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Survey, census and monitor nesting sites in New Jersey of the 17 colonial waterbird species.  
Sample Dates: Beginning: June 1979 End: Aug. 1979  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape May Point	0	No specific coordinates given in publication.
Delaware Bayshore		Same.
Glades Sand Point		Same.

- 7. Sampling Methodologies:**
  - Aerial and ground counts
  - Sample Gear, Methods and Analyses:**
  - Number of Replicate Samples:**
  - Area of Volume per Replicates:**
  - Net, sieve, or filter size:**
  - Other methodologies:**
  - Quality control measures:**
- 8. Data Processing:**
  - Tabulate summary of colonies and number adult birds in 1979.
  - Tabulate spatial distribution of heronries, gull colonies and terns and skimmer colonies
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**
  - Most thorough spatial information is for Atlantic Coast, but the Delaware Bayshore was examined, one colony located at Glades Sand Point.

**1. Cited Reference:**  
 Gelvin-Innvaer, L. 1990. Personal communication. Delaware Division of Fish and Wildlife. Nongame and Endangered Species Program. Dover, DE.

**2. Principal Investigator:**  
**Name:** Lisa Gelvin-Innvaer  
**Address:** Delaware Division Fish and Wildlife  
 Little Creek, DE  
**Telephone:** (302)739-4782 **As of (date):**  
 12/90

**3. Repository of data set or reference:**  
 Versar, Inc., Columbia, MD

**4. General Data Type:**  
**Parameters measured:** Birds - nongame and endangered species, abundance, distribution, nesting success

**5. Sample Matrices:**  
 Air - bird communities

**6. Sampling Design:**  
**Purpose of Study:** Monitor status of nongame and endangered species  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
State of Delaware	0-127	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provided summary table of nesting success of bald eagles in Delaware 1978-1990.

1. **Cited Reference:**  
Howe, M.A., P.H. Geissler and B.A. Harrington. 1989. Population trends of North American shorebirds based on the international shorebird survey. *Biological Conserv.* 49:185-199.
  
2. **Principal Investigator:**  
**Name:** Marshall A. Howe  
**Address:** Patuxent Wildlife Research Center, USFWS  
 Laurel, MD 20708  
**Telephone:** (301)776-4880 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - shorebirds, direct count
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Obtain reliable data on population status and changes of shorebird populations in North America  
**Sample Dates:** **Beginning:** 1 July 1975 **End:** 1 December 1983  
**Sample Frequency:** Every 10 days  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Atlantic Coast of U.S.		No specific coordinates given in publication.

**7. Sampling Methodologies:**

Went to areas of known concentration along Atlantic Coast and counted according to International Shorebird Survey (ISS) procedures.

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Determined peak periods of migration for each species. Determine annual indices of each species (1975-1983) and graphically depict relative magnitude of population change over a period of years (adjusting for sites not sampled). Examine populations for significant changes.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Examined population trends of selected shorebirds along the Atlantic Coast. No data were split out by area so no trends tied directly to Delaware Estuary, however, coastwide trends in species abundance should be applicable to the Delaware Estuary. Found significant declines in the population of sanderlings during 1972-1983 and nearly significant declines for black-bellied plovers. Found variance in trend estimates high compared with the BBS. Also, inconsistency of coverage of ISS within and between years necessitates elimination of many sites from the analysis.

1. **Cited Reference:**  
Hughes, D. In press. New Jersey Breeding Bird Atlas Project.  
Bradenton, FL.
2. **Principal Investigator:**  
**Name:** Dorothy W. Hughes, Director  
**Address:** 1302-63rd Street, West  
Bradenton, FL  
**Telephone:** (813)792-7469 **As of (date):** 12/90
3. **Repository of data set or reference:**  
Dorothy W. Hughes
4. **General Data Type:**  
**Parameters measured:** Birds - breeding sites, possible, probable  
and confirmed breeding of species in a  
grid
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
**Purpose of Study:** To identify and plot the location of the species  
of birds that breed in the state.  
**Sample Dates:** **Beginning:** Spring 1981 **End:** Fall 1985  
**Sample Frequency:** variable  
**Number of Sampling Stations:**

**Sample Locations:** State of New Jersey

General Location	DRBC River km	Coordinates
Entire Delaware Estuary - Cape May to Trenton	0 - 217	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Ground surveys of each block. Examine each block over 5 year period to determine which species breed there.

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:** Block - 1/6th of USGS topographic map

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Standardized sampling methods

**8. Data Processing:**

Incorporate the survey results from each block sampled during 1981-1985 to produce an Atlas of Breeding Birds for New Jersey. Data reported on possible, probable and confirmed breeding of each species within each block.

**9. Data Evaluation:**

This survey provides up-to-date information on the status of breeding birds in New Jersey. Standardized sampling method ensures that data is comparable between areas and years.

**10. Companion Studies:**

Bruning 1990  
West 1990

**11. Comments:**

This survey required an intensive search for breeding birds in the State of New Jersey. This provides a thorough description of spatial distribution of each species.

1. **Cited Reference:**  
Kane, R. and R.B. Farrar. 1976. Coastal Colonial Bird Survey of New Jersey. New Jersey Audubon Society. 2:8-14.
  
2. **Principal Investigator:**  
**Name:** Richard Kane  
**Address:** New Jersey Audubon Society  
Bernardsville, NJ  
**Telephone:** (201)766-5787 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - colonial waterbirds, number of colonies, number of individuals for each species
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide information on numbers of nesting herons, gulls, terns and skimmers  
**Sample Dates:** **Beginning:** June 1, 1976 **End:** June 10, 1976  
**Sample Frequency:** Daily  
**Number of Sampling Stations:** 4

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bayshore from Cape May to Pennsville	0-101	No specific coordinates given in publication.
Three other areas not included in Delaware Estuary	--	Same

- 7. Sampling Methodologies:**  
Surveys by car, boat and on foot. Either total ground counts, or visual estimates of birds in the air over the colonies.  
  
**Sample Gear, Methods and Analyses:**  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**  
Censused number of heronries, and breeding areas for gulls, terns and skimmers. Identified latitudinal distribution and abundance of adults.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Kane and Farrar (1977)
- 11. Comments:**  
Provides quantitative information on colonial birds in New Jersey portion of Delaware Estuary. Found no heronries on Delaware Bayshore. Some tern colonies in Cape May. Least terns nested on Delaware Bayshore and Cape May. Also mentions piping plovers.

1. **Cited Reference:**  
Kane, R. and R.B. Farrar. 1977. Coastal colonial bird survey of New Jersey. Occ. Pap. #131. New Jersey Audubon Society. 3:188-194.

2. **Principal Investigator:**  
Name: R. Kane  
Address: New Jersey Audubon Society  
Bernardsville, NJ  
Telephone: (201)766-5787

As of (date):  
12/90

3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD

4. **General Data Type:**  
Parameters measured: Birds - colonial waterbirds, number of colonies, number of individuals of each species

5. **Sample Matrices:**  
Air - bird communities

6. **Sampling Design:**  
Purpose of Study: Provide information on numbers of nesting herons, gulls, terns and skimmers  
Sample Dates: Beginning: Summer, 1977 End:  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape May County	0	No specific coordinates given in publication.

- 7. Sampling Methodologies:**  
Aerial, boat and on foot  
  
**Sample Gear, Methods and Analyses:**  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**  
Censused number of heronries, and number of breeding areas for gulls, terns and skimmers. Identified spatial distribution and abundance of adults along the New Jersey coastline.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**  
Some Cape May County data may be applicable to Delaware Estuary.  
Didn't survey Delaware Bayshore this year.

1. **Cited Reference:**  
Mellon, R. 1990. An ornithological history of the Delaware Valley Region. Cassinia: Delaware Valley Ornithological Club. 63:36-56.
2. **Principal Investigator:**  
Name: Richard Mellon  
Address: Mellon Biological Services  
Morrisville, PA 19067  
Telephone: (215)493-0697  
As of (date): 12/90
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
4. **General Data Type:**  
Parameters measured: Birds - historical, population trends over the last 100 years
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
Purpose of Study: Chronicle changes in bird populations in the Delaware Valley Region  
Sample Dates: Beginning: c.a. 1900 End: Present  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0-217	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Discuss status and trends of species found within the Delaware Valley. Discuss reasons for population fluctuations and provide lists of birds which have shown evidence of significant status changes over the last 100 years.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Data is mainly qualitative in nature but provides numerous citations from historical information relating to many of our "key" species.

Manuscript provides excellent summary of changes in bird populations in the Delaware Estuary through time. Causes of fluctuations of certain species groups are examined.

1. **Cited Reference:**  
Meyers, J.P. 1987. Shorebird migration - Feasts of horseshoe crab eggs lure shorebirds to Delaware Bay. Each Spring. Delaware Conserv. 30:27-30.

2. **Principal Investigator:**  
**Name:** J.P. Meyers  
**Address:** Natural Audubon Society

**Telephone:** \_\_\_\_\_ **As of (date):** \_\_\_\_\_

3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD

4. **General Data Type:**  
**Parameters measured:** Birds:migratory shorebirds, dominate species

5. **Sample Matrices:**  
Air - bird communities

6. **Sampling Design:**  
**Purpose of Study:** Describe importance of Delaware Bay to migratory shorebirds  
**Sample Dates:** **Beginning:** \_\_\_\_\_ **End:** \_\_\_\_\_  
**Sample Frequency:** \_\_\_\_\_  
**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bay	0-217	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Describe the four main species which dominate the Delaware Bay shorebirds: semipalmated sandpiper, red knot, ruddy turnstone and sanderling. Describes problems associated with shorebird conservation.

1. **Cited Reference:**  
Niles, L.J. 1988. Wintering Bald Eagle Survey. New Jersey Department of Environmental Protection. Division Fish, Game and Wildlife, Trenton, NJ.
  
2. **Principal Investigator:**  
**Name:** Lawrence J. Niles  
**Address:** Endangered and Nongame Species Program  
Division of Fish, Game and Wildlife  
Trenton, NJ  
**Telephone:** (609)628-2103 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - bald eagle, direct counts
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide an index of the population of bald eagles  
**Sample Dates:** **Beginning:** Jan. 1988 **End:** Jan. 1988  
**Sample Frequency:** Two days  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Most of Delaware River	Up to 217	No specific coordinates given in publication.
Most of Delaware Bayshore including all major estuarine drainage areas	0-217	Same
S. Atlantic Coast (not pertinent to this study)	--	Same

**7. Sampling Methodologies:**

Search from dawn until dusk on target dates. Delaware River observers count eagles from fixed points. Delaware Bay observers must move to cover the large sample area.

**Sample Gear, Methods and Analyses:** Binoculars and spotting scopes

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Direct counts of bald eagles, summarized by area: Delaware River, Delaware Bay and Atlantic Coast

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study gives quantitative estimates on bald eagle abundance and distribution. However, no data is presented on actual numbers in each study area, just that the distribution changed such that more were located in the Delaware River and Bay areas and less on the Atlantic Coast.

"Bald eagles have been systematically surveyed in New Jersey since 1978". Would be useful to obtain bald eagle data over time to detect trends. New Jersey has collected this information although not presented in this reference. This years count underscores the importance of several areas as bald eagle wintering habitat. The Upper Delaware, The Maurice River, Mullica River and Dennis Creek.

1. **Cited Reference:**  
Niles, L.J. 1989. Report on bald eagle nesting in New Jersey. 1988. New Jersey Department of Environmental Protection. Division of Fish, Game, and Wildlife, Trenton, NJ.
  
2. **Principal Investigator:**  
Name: Lawrence J. Niles  
Address: Division of Fish, Game, and Wildlife  
Trenton, NJ  
Telephone: (609)628-2103 As of (date):  
12/90
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Birds - bald eagle, location of nest, number of eggs, number fledged
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Identify bald eagle nesting sites in the State of New Jersey  
Sample Dates: Beginning: 1988 End: 1988  
Sample Frequency: Varies  
Number of Sampling Stations: 4

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0-217	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Monitor nests using binoculars and/or spotting scopes

**Sample Gear, Methods and Analyses:** Observers note beginning on incubation, egg hatching, fledging and other events. Also track fledged young using radiotransmitters.

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Identify bald eagle nests each spring and document number of eggs, number fledged and other pertinent information

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

New Jersey Department of Environmental Protection, Division of Fish, Game, and Wildlife has more detailed data collected during each year of this survey. This reference reports specifics only on information collected during 1988.

This paper summaries bald eagle egg and chick production in New Jersey since 1959. For the 1988 season, the only productive pair nested in Bear Swamp natural area.

1. **Cited Reference:**  
O'Shea, G. Prime Hook National Wildlife Refuge. Personal Communication. 1990.

2. **Principal Investigator:**  
**Name:** George O'Shea  
**Address:** Prime Hook National Wildlife Refuge  
Prime Hook, DE  
**Telephone:** (302)684-8419 **As of (date):**  
12/90

3. **Repository of data set or reference:**  
Prime Hook NWR

4. **General Data Type:**  
**Parameters measured:** Birds

5. **Sample Matrices:**  
Air - bird communities

6. **Sampling Design:**  
**Purpose of Study:**  
**Sample Dates:** Beginning: End:  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Prime Hook NWR	2-14	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

1. **Cited Reference:**  
Osborn, R.G. and T.W. Coster. 1978. Herons and their allies: Atlas of Atlantic Coast colonies, 1975 and 1976. U.S. Fish and Wildlife Service Biol. Serv. Prog. FWS/OBS-77/08. 211 p.
  
2. **Principal Investigator:**  
Name: R.G. Osborn  
Address: USFWS  
Patuxent Wildlife Breeding Center  
Laurel, MD  
Telephone: (301)776-4880 As of (date): 1978
  
3. **Repository of data set or reference:**  
University of Maryland, College Park, MD
  
4. **General Data Type:**  
Parameters measured: Birds - colonial waterbirds atlas, maximum breeding populations estimate for each species in colony
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Identify location of Atlantic Coast colonies of wading birds (herons and allies)  
Sample Dates: Beginning: 1975 End: 1976  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Pea Patch Island, DE	98	No specific coordinates given in publication.
New Castle, DE	102.9	Same
Surveyed entire estuary	0-217	Same

- 7. Sampling Methodologies:**  
Aerial searches, ground searches, contacting people familiar with area, etc.  
  
**Sample Gear, Methods and Analyses:**  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Custer and Osborn (1977)
- 11. Comments:**  
Provides spatial and abundance information for colonial waterbirds in the Delaware Estuary

1. **Cited Reference:**  
Roberts, C.M. 1989. The Delaware Bay: A crucial link in the migratory chain. Delaware River Basin Commission. Annual Report. West Trenton, NJ. 26-28 p.
  
2. **Principal Investigator:**  
**Name:** Christopher M. Roberts  
**Address:** Delaware River Basin Commission  
West Trenton, NJ  
**Telephone:** (609)883-9500 **As of (date):**
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - migratory
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Describe importance of the Delaware Bay for horseshoe crabs and migratory shorebirds  
**Sample Dates:** **Beginning:** **End:**  
**Sample Frequency:**  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Bay	0-217	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

General description of life history relationships between horseshoe crabs and migratory shorebirds. Describes areas set aside as refuges and examines possible threats to this fragile ecosystem.

1. **Cited Reference:**  
Smith, F. 1990. Bombay Hook, National Wildlife Refuge, DE.  
Personal Communication.
  
2. **Principal Investigator:**  
Name: Frank Smith  
Address: Bombay Hook, NWR  
Delaware  
Telephone: (302)653-9345  
As of (date):  
12/90
  
3. **Repository of data set or reference:**  
Bombay Hook NWR
  
4. **General Data Type:**  
Parameters measured: Birds - waterfowl, number of birds
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Monitor number of birds inhabiting Bombay  
Hook NWR  
Sample Dates: Beginning: c.a. 1960's  
Sample Frequency: Variable, weekly - by boat, bimonthly-aerial  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Bombay Hook NWR	53-61	No specific coordinates given in publication.

- 7. Sampling Methodologies:**  
Aerial, boat and ground surveys  
  
**Sample Gear, Methods and Analyses:**  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**  
Produce monthly and annual reports on results of survey
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**  
This survey provides information on trends of waterfowl species and relative distribution in Bombay Hook NWR (ex: Located in saltmarsh, fields, swamps, etc.). Most of the information is kept in files, very little if any computerized.  
  
Bombay Hook NWR produces a pamphlet on Birds of Bombay Hook NWR. Pamphlet contains information on relative abundance of each species by season and also indicates whether a species has nested in the refuge during the last 5 years.

1. **Cited Reference:**  
Stein, M., M. Docherty, R. Jung, and J.P. Myers. 1983.  
Migratory shorebirds. In: The Delaware Estuary - Rediscovering a forgotten resource (Pennock and Bryant, eds.), University of Delaware Sea Grant, Newark, Delaware.
  
2. **Principal Investigator:**  
**Name:** Meg Stein  
**Address:** Academy of Natural Sciences of Philadelphia  
Philadelphia, Pennsylvania  
**Telephone:** \_\_\_\_\_ **As of (date):** 1983
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds
  
5. **Sample Matrices:**  
Air-bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** Provide general information of the migratory shorebirds of the Delaware Estuary.  
**Sample Dates:** **Beginning:** \_\_\_\_\_ **End:** \_\_\_\_\_  
**Sample Frequency:** \_\_\_\_\_  
**Number of Sampling Stations:** \_\_\_\_\_

**Sample Locations:**

General Location	DRBC River km	Coordinates
Delaware Estuary	0 - 217	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Produce figures of extensive migration routes for migratory species. Discuss importance of horseshoe crab eggs. Describes Delaware Estuary shorebird reserve system and gives brief synopsis of information on 11 shorebird species.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Good general introduction to common migratory shorebirds in the Delaware Estuary. Small section by J.E. Thomas on endangered species in the Estuary.

1. **Cited Reference:**  
Stone, W. 1937. Bird studies of old Cape May. An Ornithology of Coastal New Jersey. The Academy of Natural Sciences of Philadelphia, Philadelphia, PA.
  
2. **Principal Investigator:**  
Name: Witner Stone  
Address: Academy of Natural Sciences of Philadelphia  
  
Telephone: As of (date): 1937
  
3. **Repository of data set or reference:**  
Christopher Newport Library, Newport News, VA
  
4. **General Data Type:**  
Parameters measured: Birds - abundance distribution
  
5. **Sample Matrices:**  
Air-bird communities
  
6. **Sampling Design:**  
Purpose of Study: Describe the bird life of Cape May during 1920-1930, with an account of changes that have taken place in the years that followed.  
Sample Dates: Beginning: 1920's End:  
  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape May County, New Jersey	0 - 29	No specific coordinates given in publication.

**7. Sampling Methodologies:  
Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Described status and trends of numerous bird species in Cape May County, New Jersey.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Provides historical information on numerous species which utilize Cape May for breeding, migration and overwintering. This book provides valuable qualitative information on these birds during the early 1920s-1930s.

1. **Cited Reference:**  
Sutton, C.C. 1988. Wintering raptors and waterfowl on the Maurice River. New Jersey Audubon Society. Records of New Jersey Birds. 14:42-50.
  
2. **Principal Investigator:**  
Name: Clay C. Sutton  
Address:  
  
Telephone: \_\_\_\_\_ As of (date): \_\_\_\_\_
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Birds - raptors and waterfowl, abundance and distribution
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Attempt to gain a more complete picture of ornithological significance of the Maurice River  
Sample Dates: Beginning: 1987 End: 1988  
Sample Frequency: Winter months, 21 dates between Oct. 6, 1987 and April 1, 1988  
Number of Sampling Stations: 7

**Sample Locations:**

General Location	DRBC River km	Coordinates
Milleville, NJ to the Delaware Bay	31	No specific coordinates given in publication.

- 7. Sampling Methodologies:**

Count conducted at each station for 50 minutes. All raptors and waterfowl were recorded. Surveys conducted 9 a.m. - 4 p.m.

**Sample Gear, Methods and Analyses:** Zeiss 10 x 40 binoculars and spotting scope

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**
- 8. Data Processing:**

Reports results of survey by species. Tabulates number of raptors counted on each survey day. Tabulates waterfowl counted on each day of survey and provides descriptions of results.
- 9. Data Evaluation:**
- 10. Companion Studies:**
- 11. Comments:**

Provides information on status of specific raptor and waterfowl species which winter along the Maurice River. Describes abundance of species over fall, winter, and spring seasons and provides some information on species distribution along the river.

1. **Cited Reference:**  
Sutton, C. and P. Sutton. 1986. Breeding Birds of Bear Swamp, Cumberland County, 1981-1985. New Jersey Audubon Society, Records of New Jersey Birds. 12:21-24.
  
2. **Principal Investigator:**  
Name: Clay Sutton  
Address:  
  
Telephone: \_\_\_\_\_ As of (date): \_\_\_\_\_
  
3. **Repository of data set or reference:**  
Versar, Inc., Columbia, MD
  
4. **General Data Type:**  
Parameters measured: Birds - breeding, number of nesting birds
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: Identify breeding birds of Bear Swamp.  
Sample Dates: Beginning: June 1981 End: June 1985  
Sample Frequency: Once a year (1-3 days)  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Bear Swamp, Cumberland County, NJ	≈ 68	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Ground survey, similar to procedures utilized in Audubon Christmas Bird counts

**Sample Gear, Methods and Analyses:** Binoculars

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Census Bear Swamp area of Cumberland County during 1981-1985. Itemize species in categories of 1) known to breed; 2) probable or suspected breeder; 3) breeding nearby and count number of breeding birds present.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Numbers of breeding birds present are a representation of birds in Bear Swamp. They aren't estimates for the entire Swamp. Also, numbers are not comparable from year to year because different routes were taken each of the 5 years. Considering these factors, this information provides valuable qualitative information on species which breed in or near Bear Swamp.

1. **Cited Reference:**  
United States Fish and Wildlife Service. Breeding Bird Survey. 1966-1990. Laurel, MD
  
2. **Principal Investigator:**  
**Name:** Sam Droege  
**Address:** USFWS  
Breeding Bird Survey  
Laurel, MD 20708  
**Telephone:** (301)498-0330 **As of (date):**  
12/90
  
3. **Repository of data set or reference:**  
USFWS, Laurel, MD
  
4. **General Data Type:**  
**Parameters measured:** Birds - population survey, annual index
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
**Purpose of Study:** To detect changes in populations of all bird species encountered along routes by establishing a yearly index which can be used to determine trends.  
**Sample Dates:** **Beginning:** 1966 **End:** 1990  
**Sample Frequency:** Annual  
**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Routes in PA (2) Chester County	≈ 112	No specific coordinates given in publication.
Routes in DE (10) Cape Henlopen-Wilmington	0-127	Same
Routes in NJ ( ) Cape May-Trenton	0-217	Same

**7. Sampling Methodologies:**

Observer starts along route 1/2 hr before sunrise, counts and records all birds detected in 3 minutes. Continues along route, stopping every 1/2 mile to do the same. Route is 25 miles long.

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Data are edited and examined for discrepancies or unverified observations of rare species. Data edited after put on tape.

**8. Data Processing:**

Data are edited and transferred to tape. Three listings are produced, one sorted by route, one by state and province and one by species. Data available to the public.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

The breeding bird survey has been conducted since 1966 in the Delaware Estuary. Number and location of routes run have varied since then and therefore population trends of key species over time must be examined with caution. USFWS BBS is an excellent long-term dataset for numerous species, especially those that are known to frequently call out or sing.

**1. Cited Reference:**

Wander, W. and P. Dunne. 1981. Occasional Paper No. 140, Species and Numbers of Shorebirds on the Delaware Bayshore of New Jersey, Spring 1981. New Jersey Audubon, Records of New Jersey Birds. 7:59-64.

**2. Principal Investigator:**

**Name:** Wade Wander  
**Address:**

**Telephone:** \_\_\_\_\_ **As of (date):** \_\_\_\_\_

**3. Repository of data set or reference:**

Versar, Inc., Columbia, MD

**4. General Data Type:**

**Parameters measured:** Birds - shorebirds, number birds/flock, percent of each species/flock, flock location

**5. Sample Matrices:**

Air - bird communities

**6. Sampling Design:**

**Purpose of Study:** Census migrating shorebirds along the shoreline of Cape May and Cumberland County, New Jersey and locate heavily utilized locations within this area. Determine average length of stay in these areas.

**Sample Dates:** **Beginning:** 7 May 1981 **End:** 13 June 1981

**Sample Frequency:** variable

**Number of Sampling Stations:**

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape May Canal to Salem Nuclear Power Plant	0 to 88	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Aerial, boat and foot surveys

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:** 5 aerial surveys, 2 boat surveys, several days a week for ground counts

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:** Observers skilled in identification of shorebirds

**8. Data Processing:**

Tabulate information pertaining to temporal distribution of shorebirds along Delaware Bay. Examine specifically the temporal distribution of sanderling, red knot, semipalmated sandpiper and ruddy turnstone. Discuss spatial distribution of shorebirds along New Jersey coast of Delaware Bay and also examine daily local movements of shorebirds.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

This study provides both temporal and spatial distribution patterns of shorebirds along the New Jersey Delaware Bayshore during 1981. Four species are examined in greater detail, these include: Sanderling, red knot, ruddy turnstone and semipalmated sandpiper. Information is useful in determining annual variability in numbers and species of shorebirds.



**7. Sampling Methodologies:**

Ground surveys of each block unit. Separate breeding status into 3 main categories: 1) confirmed, 2) possible or 3) probable breeders. For quantitative study - identify the number of stops out of 15 within a block that species was encountered.

**Sample Gear, Methods and Analyses:** Binoculars

**Number of Replicate Samples:**

**Area of Volume per Replicates:** Block = 1/6th of USGS topographic map

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Provide spatial distribution of breeding status and relative abundance estimates for all species encountered. Data still being processed for publication.

**9. Data Evaluation:**

**10. Companion Studies:**

PA Breeding Bird Study (Bruning, In Press) NJ Breeding Bird Atlas (Hughes, In Press)

**11. Comments:**

Thorough investigation of species breeding in the State of Delaware. Information provided for each block includes (for each species), whether or not breeding was possible, probable or confirmed and relative abundance estimate.

1. **Cited Reference:**  
Wiese, J.H. 1979. A study of the reproductive biology of herons, egrets, and ibis nesting on Pea Patch Island, Delaware. Final Interpretive Report for Delmarva Power.
  
2. **Principal Investigator:**  
Name: Jochen H. Wiese  
Address:  
  
Telephone: \_\_\_\_\_ As of (date): \_\_\_\_\_
  
3. **Repository of data set or reference:**  
Delmarva Power & Light - Environmental Affairs
  
4. **General Data Type:**  
Parameters measured: Birds - wading, number of nesting pairs, nesting parameters, flight route surveys
  
5. **Sample Matrices:**  
Air - bird communities
  
6. **Sampling Design:**  
Purpose of Study: 1) Collect baseline data on the major nesting parameters under normal pre-construction conditions; 2) Determine changes as a result of transmission line construction; 3) Assess impacts and changes caused by operation of 500kv river crossing.  
Sample Dates: Beginning: May, 1975 End: Oct 1978  
Sample Frequency:  
Number of Sampling Stations:

**Sample Locations:**

General Location	DRBC River km	Coordinates
Pea Patch Island, DE	98	No specific coordinates given in publication.

- 7. Sampling Methodologies:**  
**Sample Gear, Methods and Analyses:**  
  
**Number of Replicate Samples:**  
  
**Area of Volume per Replicates:**  
  
**Net, sieve, or filter size:**  
  
**Other methodologies:**  
  
**Quality control measures:**
- 8. Data Processing:**  
Study divided into many categories including: vegetation studies and nest distribution, soil analysis, flight route surveys, impact of 500kv line, reproductive success of birds. Each section has individual methods, results and discussion.
- 9. Data Evaluation:**
- 10. Companion Studies:**  
Cutler (1964)  
Linehan (1968, 1973, 1974)
- 11. Comments:**  
Extensive study of many aspects of the heronry on Pea Patch Island. Provides information on which species occupy PPI, examines number of pairs of herons, egrets and ibis nesting on the island between 1964-1978. Using data from this survey and previous studies. Determined that the presence and operation of the 500kv line was not expected to adversely affect the stability of the Pea Patch Island heronry or the nesting success of wading birds nested therein.

1. **Cited Reference:**  
Whittendale, T. Personal Communication. 1990.
2. **Principal Investigator:**  
**Name:** Tom Whittendale  
**Address:** Delaware Department of Natural Resources  
 Environmental Center  
  
**Telephone:** (302)739-5297 **As of (date):**  
12/90
3. **Repository of data set or reference:**  
DNREC
4. **General Data Type:**  
**Parameters measured:** Birds - waterfowl census, direct counts
5. **Sample Matrices:**  
Air - bird communities
6. **Sampling Design:**  
**Purpose of Study:** Estimate abundance of waterfowl in Delaware  
**Sample Dates:** Beginning: 1974 End: 1990  
(some back 1950s)  
**Sample Frequency:** Monthly Oct-Jan  
**Number of Sampling Stations:** 11

**Sample Locations:**

General Location	DRBC River km	Coordinates
Cape Henlopen to Wilmington	0 - 127	No specific coordinates given in publication.

**7. Sampling Methodologies:**

Aerial survey's

**Sample Gear, Methods and Analyses:**

**Number of Replicate Samples:**

**Area of Volume per Replicates:**

**Net, sieve, or filter size:**

**Other methodologies:**

**Quality control measures:**

**8. Data Processing:**

Produce Federal Aid Reports annually. Summarizing results of survey collections.

**9. Data Evaluation:**

**10. Companion Studies:**

**11. Comments:**

Some breeding bird information collected for Black and mallard ducks during spring-summer. They also conduct a weekly snow geese survey (mid-Sept. through March).

Survey information dates back into the 1950's, although prior to 1974, methods not as standardized. Have trend data analyzed for Canada Geese. Other data, not computerized yet, have as hard copy. Data beyond scope of project to examine.

**APPENDIX B**

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